AMERICAN MACHINIST

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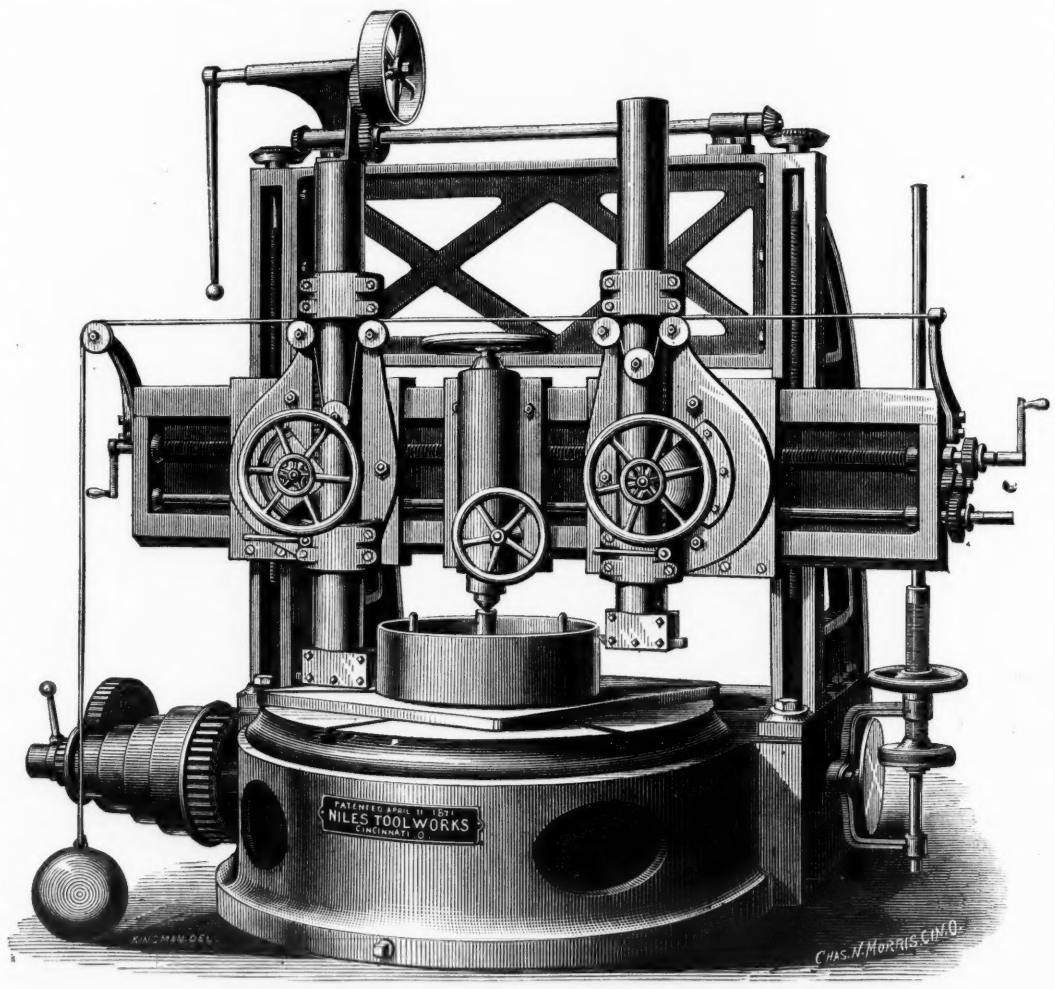
Boring and Turning Mill.

In the furtherance of our intention to present our readers with illustrated descriptions of all machines representing the modern development of machine-shop economy, we this month illustrate the Boring and Turning Mill, built by the Niles Tool Works, of Hamilton, Ohio. We choose the machine built by this establishment as representing the result of long study into requirements, and great experience in construction, the Niles Tool Works having built great numbers of these machines and placed them in every country where iron is cut.

The main point of superiority which a boring mill possesses over a lathe lies in the facility with which work may be adjusted before it is fastened. In the peculiar opportunities presented for arranging the material in the machine so as to resist to the utmost the working strains; in the capacity to sustain and operate upon work of immense weight; in the peculiar facilities afforded for the most efficient manipulation of two cutting tools; in the remarkable convenience and ease of all the manipulations; and in the marked universality of application. In adjusting work upon these machines it is simply laid upon the table and moved into adjustment without requiring any preliminary bolting or other time-consuming expedients. Unlike the lathe this machine does not call for bolts to support the work, but simply to retain and drive it. Pieces can be operated upon by this machine which baffle the most expert lathesmen in attempts to secure it upon lathes. Work of great weight, say twenty tons or more, can be placed upon these machines almost as easily as it can be placed upon the floor, and once in the machine is solidly supported and can be treated with heroic cuts without jar, as the work is not suspended upon delicate centers.



Boring and Turning Mill, by Niles Tool Works.

Two tools may operate simultaneously to the greatest advantage, both being directly under the eye of the operator, while in lathes the secondary tool involves a grand tour of inspection to the antipodes of the primal tool. The machine has a veritable front, and all adjusting devices are easily accessible. These machines are almost unlimited in their application, receiving massive work refused by lathes; doing with remarkable expedition the lightest work adapted to them; doing deep and heavy boring which cannot be accomplished in other machines; and doing very much work usually done in the planer with a marked saving of time. Many similar pieces may be fastened to the table and faced and squared with great expedition, and surfaced at high speeds if desired. There is no idle backing motion as in planers. Our illustration represents a six foot machine, but will also serve to illustrate the larger sizes up to thirty feet. The face plate is provided with a very long and large spindle running in bearings in the main frame, and extending into a pit below the machine. The adoption of the long spindle is the result of years of experience in attempts to do without it, and to find a substitute in compensating curves formed upon a short one. The outer edge of the face plate has an annular bearing upon the bed, where it rests for heavy work. The spindle has a foot step adjustable vertically by the screw shown at the extreme front of the machine.

This footstep, being raised, lifts the table from its edge-bearing and allows light work to be done while the table is supported in a manner almost frictionless. The power is applied through a pinion and internal gear, thus avoiding the lifting tendency incident to bevel-geared mills.

The belt cone is self contained in the machine, and presents great advantages over a cone supported in extraneous structures. The machine is in fact, entirely self contained and is ready for motion as soon as set upon its base. The cross rail is raised and lowered by power. The sliding heads have a quick hand traverse in addition to the power feeds. The tool bars are adjustable for all angles and tapers and are counterbalanced in such a manner that the effect is unchanged under all angular adjustment. The bars are self-feeding in all directions and have quick hand motion in addition. The tool holders are forged of steel and are universal in character. The feed is peculiar to these machines and consists of one friction-disk driving another disk which is adjustable across its face. The feed is varied as the second disk is moved from or towards the center of the driving disk, and the direction of feed is changed by moving the driven disk past the center of the driver. The infinite power of variation in feed thus presented adds greatly to the economic utility of the machine. The cut exhibits the extra attachment used for pulley work. This consists of a second head and a tail stock upon the cross-rail, and a universal driver and foot center upon the table. The foot center is a conical cavity which receives the lower end of the mandrel. The capacity of the machine for turning large pulleys is extraordinary. Mr. Hartupee, in Pittsburg, having fixed, bored, turned and removed a ten-foot pulley, 18 inch face in 15 hours, or about one-third the time usually taken by a lathe; and at the Cincinnati Exposition a 30-inch pulley 10 inch face was turned with two cuts and the edges trimmed in 42 minutes.

The Indicator Diagram. Is it, in many instances, a fraud?

BY STEPHEN ROPER, ENGINEER.

The main advantage that an indicator diagram possesses, is, that it shows what proportion of the boiler pressure is contained in the cylinder,—how early in the stroke the high pressure is reached—how well it is maintained, at what point and at what pressure it is cut off, whether it is cut off sharply, or in what degree it is wire-drawn,—at what point and at what pressure it is released,—whether it is freely discharged, or what proportion of it (in excess of the atmosphere, or in the vacuum of the condenser, according as the engine is condensing, or non-condensing,) remains to exert a counter, or back pressure,—whether before the commencement of the stroke, there is any compression of the vapor, remaining in the cylinder, and if so, at what point of the stroke it commences, and to how high a pressure it rises. Indicator diagrams supply the means by which to calculate the mean effective pressure acting on the piston, which, together with the known area and speed of the piston, furnishes the factors from which to calculate the power of steam engines. They show the steam pressure by the height to which the pencil traces the line on the paper, measured from the atmospheric or vacuum line. They also show whether the valves of a steam engine are properly set or not, whether the steam is throttled or not, the effect of small parts and connections, the point of cut-off and numerous other circumstances and conditions. In manufacturing establishments, where power is let to tenants, it will show how much is consumed by each, and will also demonstrate the degree of economy in using steam at different pressures, the benefits of expansion, and the relative efficiency of different kinds of expansion gear.

But like every thing else in use at the present time, the indicator diagram is likely to be prostituted and made the means of deception; as while the men who pretend to use it for the purpose of demonstrating the wonderful economy of their engines are, probably, as honorable as an equal number of individuals in any other calling it would be unreasonable to expect them to be more so. While every day furnishes revelations proving that new frauds are practiced in every branch of industry or commerce, and in every trade, profession, pursuit or calling, it cannot be expected that the indicator diagram has escaped, or that it is not doctored. There are indicator diagrams exhibited every day that never saw the cylinder of an indicator, in being made from templets, and showing wonderful conformity to theoretical requirements.

I wrote to a friend of mine in New York a short time since, requesting him to procure me some indicator diagrams from the best compound engines that he knew of. He informs me that he called on the chief engineers of several of the large steamship lines, and requested some cards, which were cheerfully given when they had any on hand. In one instance, a very obliging gentleman informed him that he had not had the indicator applied to any of the engines of his line recently, but he thought he could accommodate him. He then took a piece of sheet zinc from a drawer, and, with a lead pencil, struck off some beautiful diagrams, which my friend mailed to me. They were probably a facsimile of some that were taken from the same engine perhaps several years ago, and showed results far superior to any thing the same engines are capable of doing at the present time. The opportunities for deception by means of indicator diagrams are very easy, as a knowledge of their value is confined to very few; this arises from the

fact that heretofore the manufacturers of indicators held them at such a high figure as to place them beyond the reach of such engineers as might wish to possess one. An indicator that would pay a handsome profit to the manufacturer at $20.00, now sells at from $80.00 to $100.00; as a result there is not one quarter as many of them in use as there would be if they could be purchased at any thing like a reasonable price. Then again, what sympathy do the owners or purchasers of steam engines deserve when they are cheated and deceived by means of indicator diagrams? How many of them ever purchased an indicator for their engineer and encouraged him to make himself acquainted with its functions and uses? Very few; nor would the engineer get any thanks, except in very few instances, if he bought one himself, and by means of it pointed out to his employer the impositions to which he was subjected.

There is a rivalry between the prominent steam engine builders of the different sections of the country, and neither party will allow themselves to be outdone in the production of beautiful expansion curves and sharp corners—if these conformities can be secured by tinkering with the diagram. Each section of the country has its favorite "experts"—in fact, every prominent steam engine builder has. They attend all the exhibitions, and are expected to lean to the side of those who employ them year after year. Indeed it would not be in accordance with human nature if they did not. Two of the most prominent steam engine builders in this country openly charged one another at the Mechanic's Fair at Boston in 1878, with doctoring the diagrams taken from their respective engines.

I have in my possession several pairs of diagrams that were taken from prominent automatic cut-off stationary engines, and also compound and marine engines, all showing wonderful conformity to theoretical requirements, and in some instances the indicator had to be moved from one end of the cylinder to the other. It is hardly possible that the adjustment can be accurate and refined, and the conditions so nearly equal as to produce a pair of diagrams as nearly alike as peas in a pod. They *may* all have been honestly produced, but, as with Caesar's wife, when suspicion is once aroused doubts will always attach to such beautiful productions of the "*expert's art.*"

Now, Messrs. Editors, the foregoing article was suggested by hints frequently thrown out by engineers, and I thought the only way to ascertain how much ground there was for suspicion, was to give the subject a shake, as the best means of furnishing an opportunity for others to express their opinions.

The Birdsall Portable Engine.

The Portable agricultural engine has become an indispensable article of working economy. It is also one of the few subjects of invention on which the most extraordinary versatility of new ideas have been expended. The principles involved in the engine, herewith illustrated, are so far in advance of general usage, that it is due to the public that an explicit statement of its advantages should be shown. Since the introduction of steam power for driving farm machinery, there has been a growing demand for engines in the best grain-growing regions, and farmers generally prefer them to horse power. The only objectionable features which have not been overcome is the excessive weight, (being too heavy to haul about the country), and the large amount of fuel and water required to supply them. The manufacturers of this engine have carefully noted these facts, and by close observation and experience have been enabled to produce an engine proportionately light, durable, and economical.

They are designed in a plain, substantial style, of as few pieces and parts as possible, with large wearing surfaces, and small number of wearing joints, thus avoiding complications and liability to extraordinary wear. The cylinder, steam-chest, elbow-pipe connections, guides, frame, crank shaft box, valve-stem guide, and bracket supports are cast in one piece which is attached to the boiler by broad heavy brackets about 16 inches apart, and so arranged as to obviate all trouble from unequal expansion. The cylinder is jacketed, has a diameter of 7 inches, and 9 inches stroke of piston. The guides are made concave, which allow the cross-head to travel freely, without cramping in the least. The crank-shaft is of steel 2¼ inches in diameter. The valve-stem, piston-rod, and wrist-pin, are also of steel. The connecting-rod is of the best quality of wrought iron. The feed-pump is attached to the under side of the waist of the boiler, and is worked by a spurr-wheel driven by a pinion on crank-shaft, which reduces the motion, and obviates the hammering and wearing out of the valves, and insures perfect action of the pump. Its position, being vertical, also adds to its efficiency.

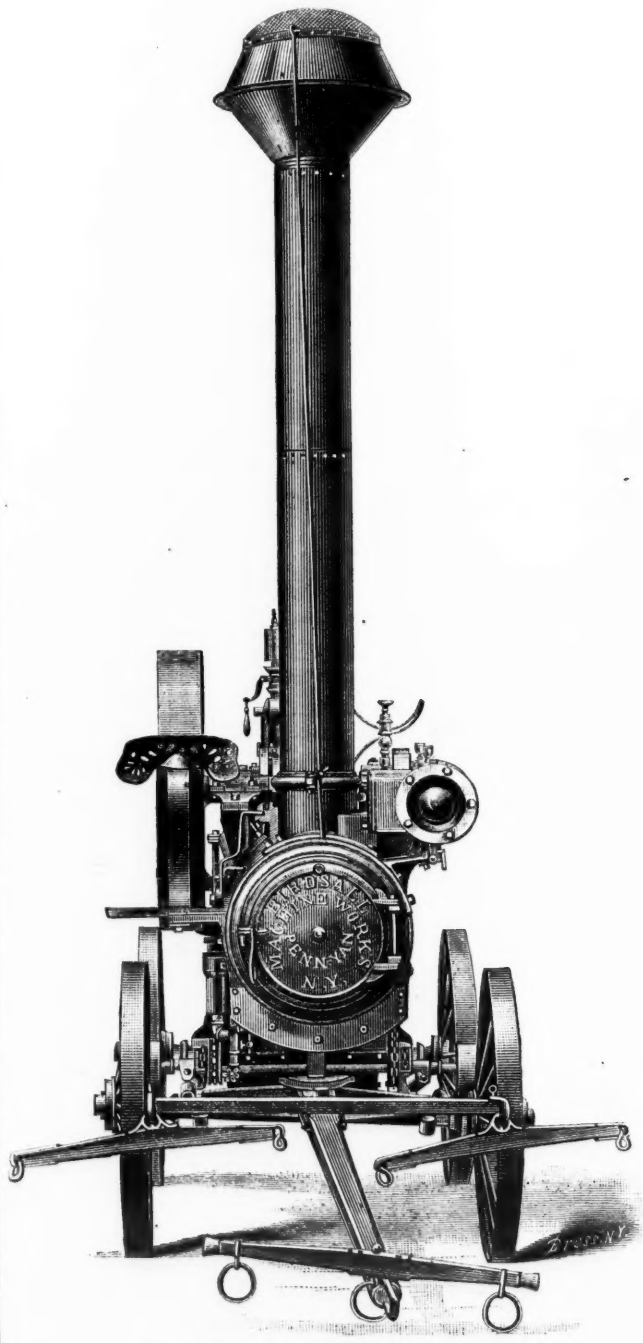


FIG. 2—FRONT VIEW, SMOKE STACK UP.

By reference to figure 3 it will be seen how accessible and convenient it is, and how it is connected. The balance driving-pulley is 40 inches in diameter, and makes 220 revolutions per minute and, being placed on opposite side of boiler from the engine, together with the pillow block, pump connections, &c., distributes the weight equally on the boiler, and secures a well-balanced machine, with sufficient distance between the journals, so that the engine neither strains, or wears out of proper line. Figure 2 will show how well these parts are mounted. The governor is situated just back of the dome, and is flanged to the boiler, and receives steam through a 1¼-inch pipe, which communicates with the dome by a connection made in common with the safety-valve. The throttle is placed in this pipe where it connects with the governor, and is very easy of access. From the governor the steam passes through a pipe inside of the boiler, above the tubes into the smoke-box, and then by a very short connection directly into the steam-chest and cylinder.

This method protects the pipe from cold air and consquent condensation, and actually *super-heats* the steam. The heater is placed directly under the smoke-box end of the boiler, and is so constructed as to allow every pipe, elbow connection and bend in the feed-pipe itself, to be perfectly drained in freezing weather, and also the case through which the exhaust steam passes.

The amount of heating surface obtained, by passing so much feed pipe (about 7 feet) through the heater in contact with all of the exhaust, brings the water to nearly the boiling point. The heater case also serves, in a very substantial manner, to make the attachment to the front axle, and as a saddle to support the boiler. The boiler is of the locomotive pattern, but not of the ordinary style for portable engines. The shell is 24 inches diameter and contains 46 tubes, 1¾ inches diameter and 66 inches long, and extends beyond the tube sheet 12 inches, forming the smoke-box. The fire-box end of the boiler is what is known in locomotive practice as the wagon-top form, being made with the sheet which forms the shell of the fire-box several inches higher on top than the tube shell, connecting with the latter by a taper waist, and surmounted by a steam dome 16 inches high and 10 inches in diameter, which together forms a large steam and water space. The fire-box is 30 inches long, 20 inches wide, and 24 inches deep, and is provided with rolling grates, which are actuated by a lever outside for cleaning the ashes. The trucks are of all wrought iron except the hubs, and are made in a superior manner. A very novel and efficient brake is provided, which is readily operated from the driver's seat. A very efficient device has been arranged to open and close the cylinder cocks, when stopping and starting, without the attendant being obliged to leave his place of firing. Nothing is omitted in the construction of these engines and appendages, and they are offered to the public as the most desirable agricultural engine in the market. The entire engine with all completings weighs about 4,500 pounds. For further particulars, address the manufacturers, E. M. Birdsall & Co., Penn Yan, N. Y., and 248 Johnson street, Chicago, Ill., or W. L. Chase & Co., 95 and 97 Liberty street, New York.

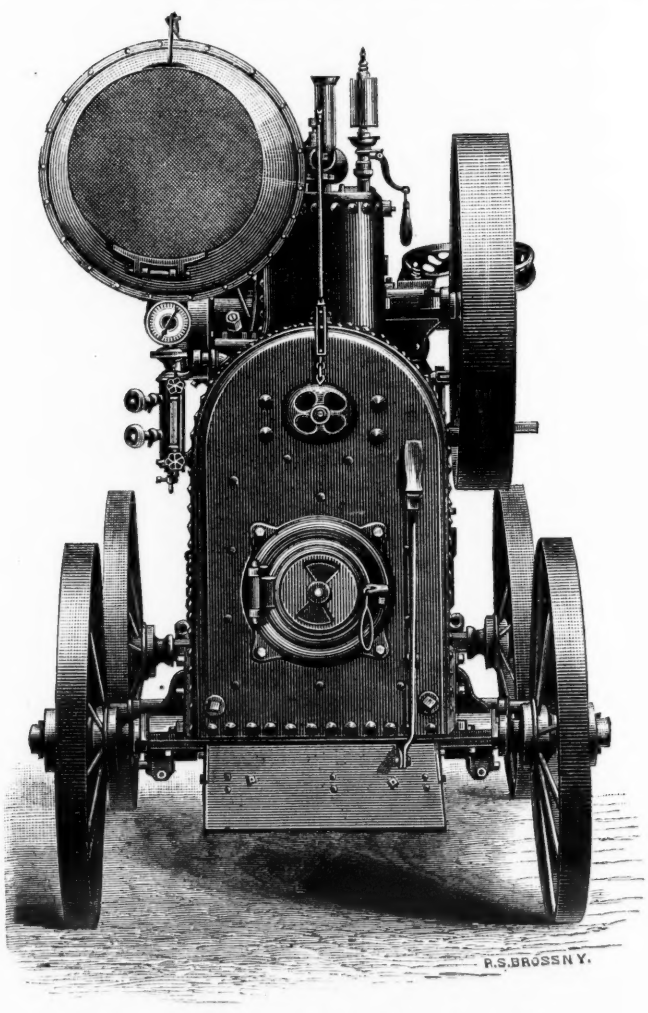


FIG. 1—BACK VIEW, SMOKE STACK DOWN.

Extracts from Chordal's Letters.

Messrs. Editors:

* * * There certainly can be no better or surer sign of returning prosperity to the trade than the growing scarcity of craftsmen. Two years ago ye heartsick tramping jour greeted us daily in search of work at a dollar and a-half a day. He was hard up and hard looking. He had no tools, not even the inevitable twisted scriber. His breeches were patched in the seat and the patches were worn out. He was really out of work and in search of work.

Now he don't come at all. He has work at wages ranging from $1.75 to $3.00 per day and receives letters daily asking him if he wants work. He has had a hard time of it and will welcome a new order of things. He has always made one mistake, and the sooner he finds it out the better. The average machinist considers all machinists the same and thinks they should all receive the same pay. He has a certain amount of bigotry about him and cannot be convinced that he is not as valuable a man as there is on earth. You find it hard to convince him that he is worth more or less than others. He will kick if he gets less wages than others, and others will kick if he gets more. I have worked as journeyman in fort; different machine shops, and I give it as my solemn conviction that my prosperity has been more retarded by the narrow-mindedness of my fellow workmen than by the greed of my employers. The most uncomfortable shops I have ever worked in have been those where I was best paid. I never failed in making satisfactory terms

with employers, but I never could make any terms with shop mates. I never yet knew of a case of one workman lending a helping hand to another, if that help had a tendency to raise the helpee above the helper's pay. There's a good time coming, boys, and a better chance to start new in this thing will never occur. Make yourself as skillful as your talents will permit. Insist on working in places and on work where your skill can be best applied, and insist on receiving market value for the grade of skill you sell.

Study the thing well and grade yourself. You know very well of workmen who are worse workmen than yourselves. Men who if you or I had the say so about it would quit the bench and go to cleaning castings or pounding sand. You know they are not valuable men at the same work you are on. You know they are not worth the money to the shop that you are. You think the employer a fool for paying them the wages he does when many better men could be had at the same pay. You and I know this mighty well But we also know that there are men far more valuable than we. Men who do twice the work without sweating half so hard Men who do nice work which we never dared to attempt. Men who can do work without tools and are never helpless. They are mighty workmen whose skill we should envy. We know such a man is worth more money than we are, and that we are doing ourselves injustice when we make things warm for him because he gets a quarter a day more than we do. It is honest truth that most employers treat men with more consideration than the men treat each other. I have raised my pay several times and feel justified in giving machinists a little advice on the subject, and unhesitatingly say that if you will follow what I say in the next few lines, you will get good wages in the next six months. First and foremost, settle with yourself what you are good for and what you are best for. If you are a lightning man on fine close work don't go to a threshing machine shop for a profitable job. You will be worthless there. If you are a tip top lathes-man, don't go to botching work at the vice. Good vice hands are in demand to-day at fair wages. So are good lathesmen on good work, and so are crack lathesmen on rough work. Bad ones can't get jobs at any wages, and all are bad if working on something they can't do satisfactorily. If you are a good and valuable workman in any branch of the regular machine trade you can get work in that branch, if you will use good sense in determining your proper grade.

Don't haggle about wages, and don't ask for some other man's wages till you know for sure that that man is as valuable a man as yourself.

Prove your worth in the shop and you will get your money, and when you prove more valuable you will get more. Now comes the golden rule. Keep your mouth shut and don't tell any man, woman or child on the face of the earth what wages you do get unless you don't get what you are worth, in which case go to the office *alone* and fix it at once. Remember that. Don't brag about your wages to any soul as long as you live. If you get a raise and blab it, the bosses will kick you out for your lack of sense, or the other boys will freeze you out for your good luck.

No man under heaven could carry on business successfully if he told his competitors all about his business and kept his books open for inspection. Keep mum about your wages. If some bank cashier asks you how much pay you get, ask him how much he gets before you answer. * * * *

Good workmen are not only getting scarce, but they have been scarce for some time. A good workman is generally a good common-sense sort of a man in every way, and when the panic struck the trade he showed his sense by making other arrangements. The consequence is that—to-day an increased business finds that the only source of special supply is a mass of material first discarded from the shops, on account of their being the least valuable. Those who have served their apprenticeship during the dull times have become discouraged at the small wages they were to receive as jours, and if they were ambitious they quit and abandon the trade. This left the slouchy cubs in the shop. Those short-sighted employers who think they can make money out of the machine business, if they can only get men at low enough wages, have had their chance. It will be long before they will have another such chance, and I now make all such employers an offer. I will bet a fifty cent summer hat with each of them that there is more profit in a job done by three-dollar men than there is in the same job done by one-dollar men, other things being equal. Low wages means a low grade of workman, and that means a high first cost of product. I speak of comparative wages, of course, comparative with reference to the grade of work.

* * * * * Some machinists when they speak of a good workman mean a man who is fine, close and accurate. This is not correct one half the time. There are just as good men working on rough portable engines as you can find in the shops. They are skillful men. But put them into shop building tools and they are gone; fact is they should not have come. In the same way the tool man ain't worth his salt on the portable engines

He accomplishes nothing and is hard at work all the time. Some folks think a job can't be done too well. Nonsense! There's more work done too well than too bad. It is no trouble to go and contract for good work and get it; but it is hard to get rough work properly done. Some one has said that dirt is simply matter misplaced, and I say that bad work is simply labor misplaced. If I saw a man painting a sewing machine shuttle with coal tar I would say he was botching the job, and if I saw him putting a crocus finish on a hand-car crank I would say the same thing.

If a man grinds up a sugar mill roll on a Morton Pool machine he makes no better job of it than if he had taken a single roughing cut over it. A skilled workman is one understanding the tricks and arts of his trade. If he has the judgment and common sense which tells him how and where to apply his skill he is a good and valuable workman. If he does not know how and where to apply his skill he is not a good and valuable workman. There are more bad skillful workmen than good ones, and the thing must be equalized by supervision. The foreman is to supply the judgment, and the workman the skill. A skillful foreman is generally a bad foreman, for he has judgment mixed up with his skill and supposes that every other skilled workman has judgment also. He will give a man a job and leave him to his own devices, and if the job is badly done he will lay it to the man because he knows he could have done it properly himself. Such a foreman often says its more trouble to instruct a workman than to do the work. A foreman with more judg-

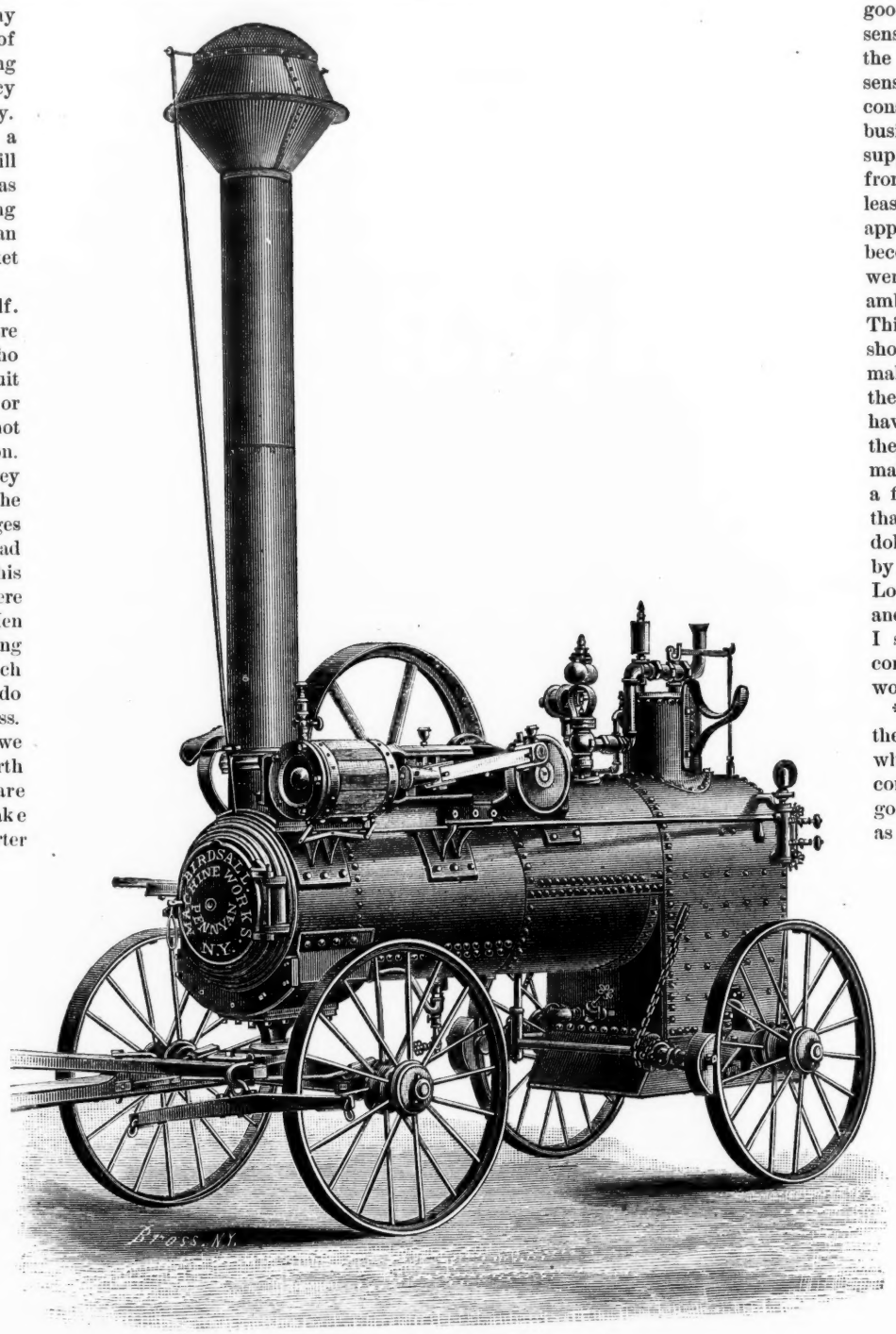


FIG. 4—SIDE VIEW, SMOKE STACK UP.

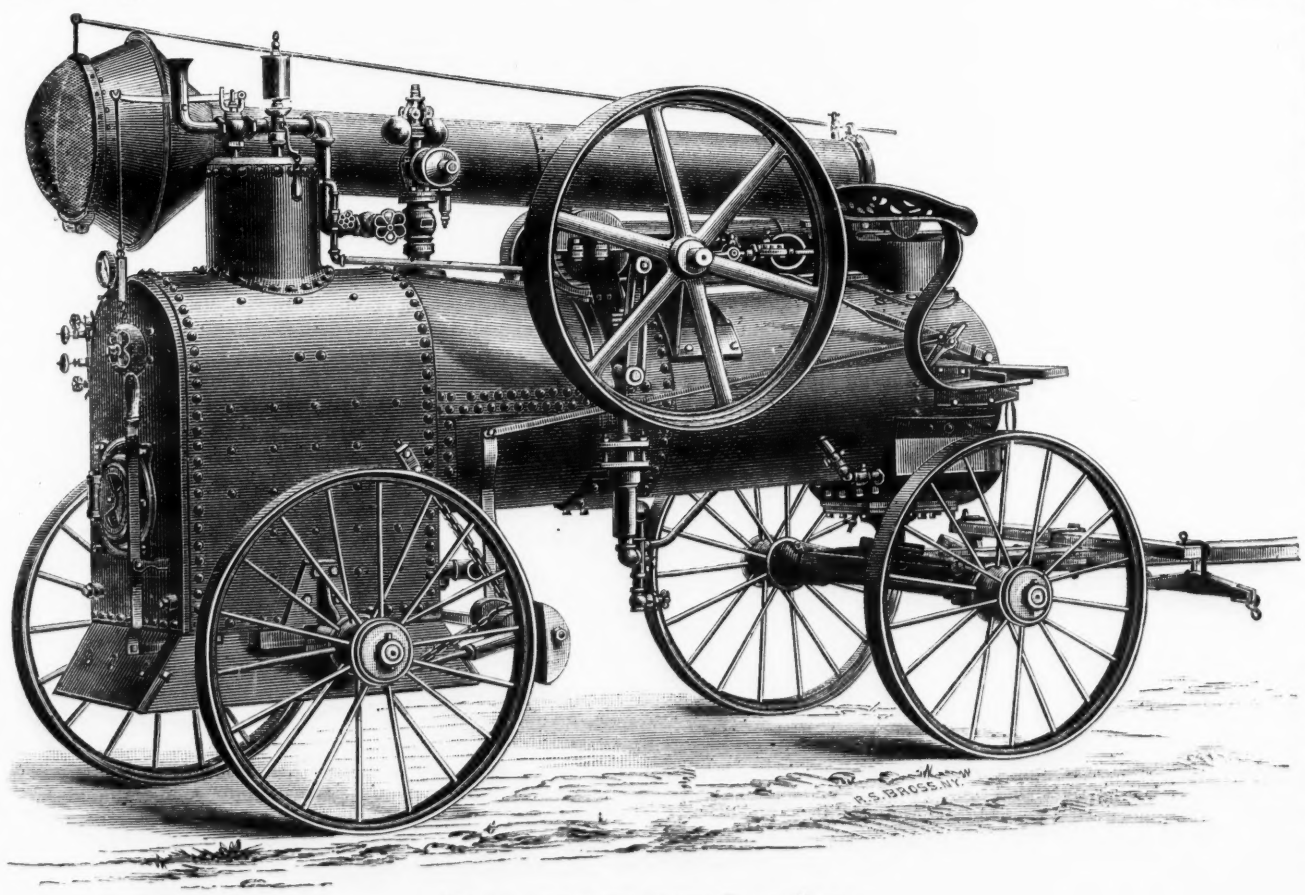


FIG. 3—SIDE VIEW, SMOKE STACK DOWN.

ment and less skill would advise such a workman to quit the machine trade and go into the post hole business, on account of its being less abstruse.

* * * * * * Mr. Grant thinks I'm a little off on the little planer question. I will accept the view taken by him, and at the same time hold that it is not antagonistic to my own as originally put. I've "been thar" too and have worked for many weary weeks on connecting rods for twenty inch engine, and have often sighed for something,—*anything* in the way of a planer.

A man at a vise can philosophize and be sweet tempered and feel satisfied with the action of his chisel, and can go home and dream properly. But put a big rod into one of the light cutting planers and you will suffer the torments of the damned. You will think every time the planer makes a stroke that it ought to hold a better cut than it did the last stroke, but it won't. Deliver me from the dreams following such a crazy day's work. Honestly and truly, as a workman, if I had the choice between such a planer as I referred to, and a vise I would prefer to "run" the latter for the sake of my own good nature.

As a proprietor, I hold that if a one-horse shop gets a little planer it will never get a proper sized one, and if it never gets a little one it will some day get a big one, a consummation most devoutly to be hoped for. Look at the motives, Mr. G., and aid me in any action which will cause any one proprietor to come some day into the possession of a good sized machine. Look only at the facts, let my opinion go, and try and find a common country machine shop which started with a little planer and then got a big one. Such shops never need two planers.

* * * * * Now I want to give you one, Mr. Grant. If you know anything about milling machines, or are in contact with men who do, absorb their knowledge and tell us about them. Not a single verse or a single chapter, but a general and detailed view of things. Like many readers of the A. M., I have run milling machines in tool rooms for years, but I know nothing of them as regular manufacturing machines, and I feel that, like myself, many others wish to hear from the authorities, not on planers you know, but on milling machines.

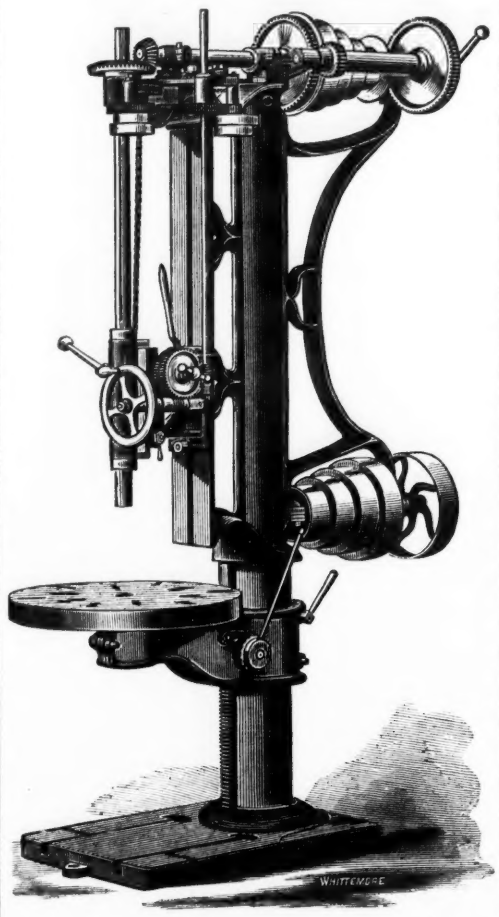
* * * * Yours truly,

CHORDAL.

Improved Upright Drill.

The above cut represents an upright drill of recently improved patterns, built by P. Blaisdell & Co., of Worcester, Mass., in which is contained some specialties—one of which is a very simple device for a quick-return motion, invented by Mr. Blaisdell, the founder of the works. When the drill has reached the bottom of the hole that is being drilled, by a simple movement of a lever operating a cam, it disconnects the worm from the gear and allows the drill to be withdrawn at a rapid speed with a rack and pinion, instead of the slow motion used in feeding down, as is usually the case. The spindle is perfectly balanced with a weight inside the column attached to the spindle with a chain running over a shive in the top of the column; the head is also balanced in the same way, each being independent of the other, therefore insuring the perfect balancing at any position they may be left in. The spindles are made of cast steel, and have the "Morse Twist Drill Shank" taper in the end to receive the drill, or socket. The wear on the collars is compensated for by two check nuts on the spindle above the slide, which can be readily adjusted so as to prevent the drill from dropping through and breaking, or doing some other damage; all the nuts and bolts that come to wear are case hardened. There is also a very simple device for power-feed which is put on if desired; they are made with or without back gears on the head.

This firm build various sizes, from very small ones to fifty-inch swing. They have recently made new patterns for a Lever Drill which is very simple, and combines the quick-return motion with the lever. For



small, quick running drills this is well adapted. These drills are made from recently improved patterns; the firm being composed of practical men of long experience, and they are constantly on the alert for any thing which will tend to improve their tools. Their shop has kept busy through the dullest times, and is now running to near its full capacity on orders.

An Engineer's Views on Some Statements in Mr. Church's "Engineering Popularized."

Messrs. Editors:

In "Engineering popularized," No. 2, February number of the MACHINIST, we are told by Mr. Church, "*that the area MkCNO represents the most perfect ideal performance of the steam,*" *and we naturally infer that in an engine making such a diagram we should realize the highest attainable economy. On the contrary, this is all wrong, and I may assert that if such a card were described by any engine now made, we should find results on the coal-pile quite materially short of what might be secured.* Such a card has, indeed, been one of the chief articles of my faith since I knew anything about an indicator diagram, and now to be told that it is all wrong makes me feel quite aggrieved. It is true, I never saw an indicator diagram taken from a crank engine with a perfectly square heel, but I have seen facsimiles of cards said to have been taken from some celebrated engines in which the heel was little short of being square, but then I always entertained the idea that they were fixed up to serve a certain purpose—the said purpose being to hoodwink, or deceive some unwary buyer. That cards are fixed up there can be no room for doubt, I think, since some of my information comes from those who acknowledge to having done so. Ex-United States engineers have told me, that, while in the navy whenever the cards did not *pan* out as they ought to have done, the said cards never failed to be touched up by hand, these cards, I suppose, finally finding their way to the office of the chief engineer of the navy, who accepted them as genuine. It perhaps made his heart glad to think that certain arrangements in the valve gear, shape of the valve, or something else he had ordered to be done, turned out so magnificent a result. The result of the fixing-up was probably the ordering of another pair of imperfect engines for the next ship.

My impression is, and hitherto I have seen no reason to change, that the greater the area within the lines described by the indicator, with a given initial pressure, point of cut-off the same, and expansion curves of equal value, the greater will be the effect on the piston, from the same quantity of steam; and therefore the card having the least rounded heel will show the greatest area. Now, I hold that any compression greater than is necessary to bring both ends of the connecting-rod up to their respective positions (fix against the crank pin and the cross head wrist, to prepare *it* for the return stroke of the piston) is a reduction of power and a waste of fuel. I take the view that the engine ends at the cross-head, and that the connecting-rod is a means of *connecting* the engine proper to the crank for the purpose of getttng rotary motion. Taking this view, I would ask why the piston should be opposed in any part of its progress on *account of itself*—it seems to show that it should not be opposed on any consideration if it can be helped. But experience has proved that with the best means known to *connect* the engine to the prime moving shaft from which we want to get circular motion, on account of what may be called imperfection we have to oppose its progress to suit our imperfect connection. Reasoning in this manner, is it not best to oppose the piston as little as possible and as late as circumstances will permit? According to the diagram the exhaust valves closed, when the piston had completed four-fifths of its stroke, leaving it to travel one-fifth against increasing opposition to the end of its stroke, the momentum of the fly-wheel being alone depended on to bring the piston to its position in order to receive a fresh impulse from the steam in the boiler, to drive it in the opposite direction. Whatever momentum is taken from the fly-wheel at the end of the stroke of the piston has to be returned to it again at the commencement of the next stroke; therefore, the later we begin to take power from it the more power there will be left to carry the crank past its dead points, and the less will have to be returned to it; I cannot but consider Mr. Church's point of the beginning of compression as excessive, his point is, in fact, just double the amount that a celebrated engineer of this city once told me that he had found necessary in his practice. I do not believe any rule can be given to suit all engines; speed, kind of work, rigidity of the engine itself, and the character of the workmanship play an important part; each engine should be tested to ascertain how *little* compression may be used. I have before me some cards taken from an automatic cut-off engine, when her exhaust valves closed to suit Mr. Church's argument up to nature; no, I am too fast, because the steam was not compressed equal to initial pressure, viz: from 8 to 10 lbs. Since then the exhaust valves have been made to close at a point equal to one-fifteenth of the stroke, and (since no alteration has been made as to the time of the opening of the steam valves they are regarded as opening at the proper time, viz: at the beginning of the stroke), the result of the re-adjusting of the exhaust valves was an instant reduction in the boiler pressure of 20 lbs. to the square inch. This is stating it very mildly, as the engine can, and does do more work with 70 lbs. boiler pressure than it could formerly do with 100 lbs. under the old condition; and does it with not less than 100 lbs. of coal per 10 hours than it previously required.

I know of another case where it would seem that the builder must have held some such views as Mr. Church. This engine between taking its steam too soon, and closing the exhausts too early, was compelled to carry a boiler-pressure of 110 lbs.; it is doubtful if the steam was compressed up to the initial piston-pressure, but as no indicator was ever applied there is no proof that this was not the case. After the engine had been in use some years in this condition, and *always in trouble*, a change was made in engineers. One was employed who possessed at least three parts common sense, and this common sense-view the new man had, he attached as an indicator.

The results were that the steam valves were made to open later, and the exhaust-valves to close at the latest practicable moment. Now, what is meant by the latest practicable moment is, when there is just compression to carry the crank past its centers without being heard. The result is a working-pressure in the boilers of 80 lbs., and a lessened consumption of coal. I have said nothing about clearances, or the spaces between the piston and the cylinder-heads at the beginning of the stroke, or the space between the inside of the cylinder and the valves, to which there is so much importance attached, nor neither does it matter how much or little they may be. The above are the practical results of actual cases now at work. If a person should propose the compression doctrine to me in my engine-room with a view of applying it, I would suggest to him, that there was a man down the street who wanted to see him.

I have known cases on the other hand, in which the exhaust closed so late as to leave no compression, and in which no steam was admitted, until the crank had reached its center. The results were loose crank-pins in a short time. Some practice what they call *impression*, or the admitting of steam to the cylinder before the piston had finished its stroke in order to cushion—it is a dangerous experiment at the best. I am a friend of the indicator, and coincide with Mr. Church, that no engine should be considered complete until one has been applied, but I do not think it tells quite so much as some people claim it will.

It seems to be an impossibility for any engine to ever show a card with an expansion curve equal to the adiabatic; everything points to the contrary. Not only does the heat escape through the walls of the cylinder, the bed-plate to which it is attached, every bolt, nut, valve-stem, piston-rod, cross-head, &c., in fact, all attachments act as conductors, and contribute to abstract the heat. If an Electrical machine had as many points about it, and were no better isolated to prevent the fluid from escaping than the steam engine is, the Electrician would not be able to get any great results; nevertheless, the proper thing to do is to try and equal it. Even if it cannot be attained such practices would not only cause the cylinder to be looked after, but also all other points connected with the engine, instead of finding improperly protected boilers, uncovered steam-pipes, and such like practices the rule, they would soon be found the exception. That party who caused a 2-inch steam-pipe for the dye-house to be inserted in the engine's steam-pipe, ought to be awarded a leather medal. However, this is no worse than many other cases continually turning up to the dismay and discomfort of the man who runs the machine. In article No. 3, March number, Mr. Church says: "To run the adiabatic curve" *the mathematician will recognize the equation of the adiabatic curve to be* $-P \infty V^{-\frac{10}{9}}$ *— which looks ugly.* The mathematician may recognize it, no one else would. After an explanation consuming some ten lines, he says, "which is a good deal of meaning in a small compass." Now, if Mr. Church wants to popularize this subject, he must talk to us engineers in a language which a common school education will enable us to understand; he need not talk to the owners, for, as a class, they neither know nor care for the subject. Let us have plain English, with plain, old-fashioned figures for proof; he will find that some of us at least, can follow him in his cube roots and 10th powers. I have a work for *beginners*—one of its subjects is to prove that a certain kind of engine *ought* to perform a duty of 150 millions, which he does in plain figures that almost any school-boy might understand, but in order to prove that it cannot be accomplished in practice, he launches off into four pages of Algebra. A certain firm in this city bought a scientific work from A to Z, it was nothing but Algebra, there was one part of it that was too much to comprehend. It happened that the author stepped into their office one day, and, after the usual civilities were exchanged, he was asked for an explanation; he could not give the desired information. I suppose he did know when he wrote it, but it was past his comprehension

to impart to others then, what he meant when he wrote it. Now I would like to know what is the use of such formulas? They seem to be past any fellows' finding out; so I hope if Mr. Church must use Algebraical signs he will explain the meaning of them before he puts them together.

Again he says: "The efficiency of the diagram in the Fig. is only 78 per cent., and yet the diagram represents the performance of a first-class engine." I should hope for the sake of the credit of the steam engine builders of the country, that there are as few as possible of such first-class engines—taking the diagram for it, and from the moment the piston started on its journey there is a constantly decreasing pressure, there is no well-defined point of cut-off, and so far as the steam line goes, it shows either a want of room for admission of steam, or a terrible leak somewhere; the point of release is almost too good to be genuine. I am of the opinion that that part of the diagram has been fixed up to suit the occasion, it's hardly possible that there was steam enough left in the cylinder to effect such a compression as the card represents, however, this might be done by admitting steam through the steam-valve to accomplish it.

I think there is a great deal of flippancy in this talk, and in the showing by card, that the initial-pressure on the piston is equal to the boiler-pressure. The chances are against such performances, let the steam-pipes be ever so straight and large, and I presume there are none which have less than one right angle in them between boiler and stop valve, and perhaps three or four more before the piston is reached, making quite a tortuous passage for the steam to travel, and if we take into account the moving of the piston away from the entering steam, at the rate of hundreds of feet in a minute, the chances are rather slim that it will be followed by a pressure equal to that of the boiler. I believe slide-valve engines are made whose initial-pressure is not over 20 lbs. less than the boiler-pressure, but they are probably rare. I am not yet prepared to believe that any cut-off engine has ever showed an initial piston pressure equal to that of the boiler. So far, Mr. Church has not said whether the diagrams were made by slide-valve or an automatic cut-off; we are left to infer the latter. It would also be desirable to know, when he gives us a card, to inform us of what build of engine it came from, if a condensing engine, the kind of condensing apparatus used. I do not know what his experience is, as to some persons views of what a vacuum consists. Mine is, that very few of those who profess to know, agree with my understanding of it. This property of a vacuum *pulling* a piston while the steam is pressing against it on the opposite side, I never could see through, yet some of these persons were anything but ignorant in many things; perhaps an explanation of what its properties consists would not be out of place, as it must not be taken for granted that all of us are equally well informed.

WM. J. WILLIAMS,
Philadelphia, Pa.

New Power Planer.

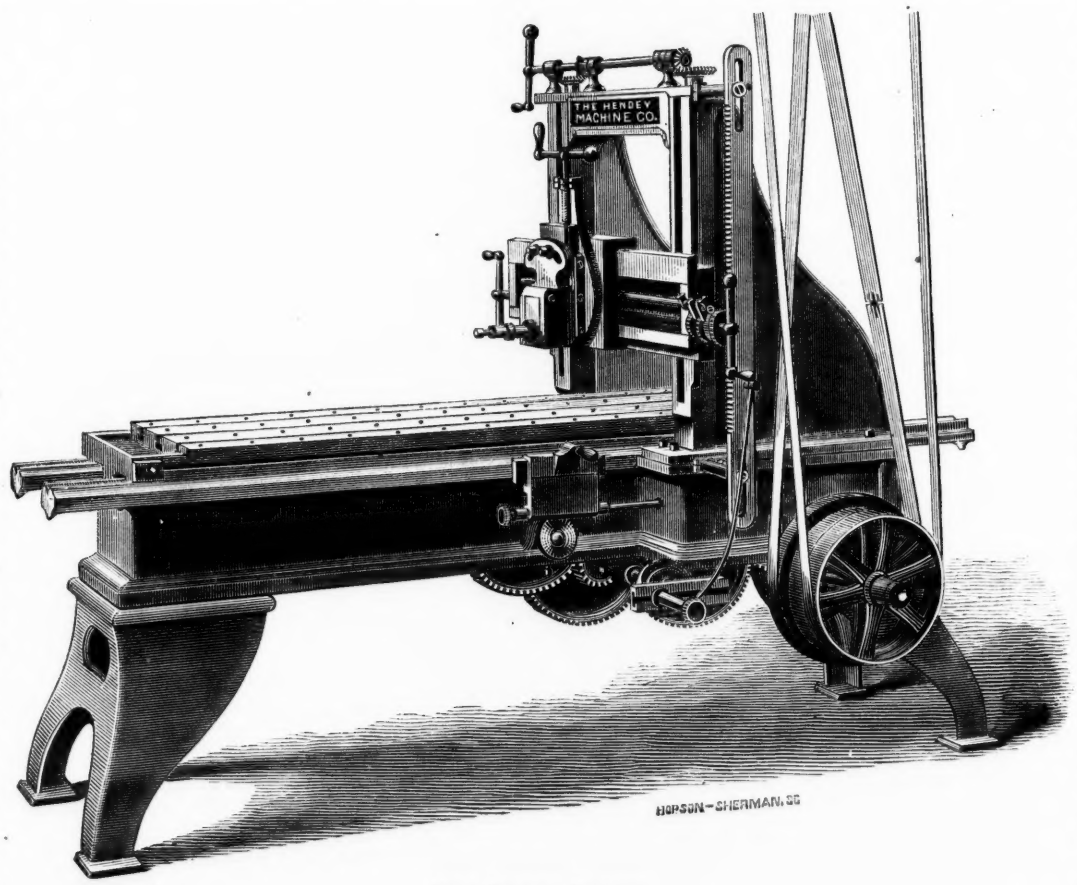
The planer illustrated on this page is manufactured by The Hendey Machine Company, of Wolcottville, Conn., and is without doubt a great improvement on the old style of planing machine. We had the pleasure of visiting the works of this company recently, and saw several of these tools in operation, and were much pleased with the manner in which they worked, and the ease with which they are handled.

The improvements consist in the reversing motion (which we so fully described in the March number of the MACHINIST, in our description of a 24-inch shaper made by this firm) by means of which the table is reversed without changing belts from one pulley to another as on the old style of planers, thereby getting rid of the belt-squeaking annoyance, and making a saving of power and belts, and securing a uniform and accurate stroke, for by this arrangement the table works up to a line regardless of the width of cut taken. For instance, the stroke or movement of the table may be set to merely pass the tool through to the end of the piece to be planed *without* any cut. Then the tool may be adjusted to take all the cut the machine will carry, and it will work up to the same line as before the tool was so adjusted It will also feed down automatically, stopping in the center of a hole, for instance, as in planing key-seats in shafting, &c. This method of reversing the table without shifting of belts allows the use of a graded, or cone-pulley (as shown in the illustration), giving the tool the great advantage of being speeded to the maximum for cast iron, brass, or other soft metal work, and a slower rate of speed for steel, or material of similar nature. All mechanics can readily perceive the great advantage of having this grade of speed, for it is as essential to a planer as to a lathe.

The important feature of the planer in its working so closely to a line cannot be overestimated, working as it does with almost the accuracy of a shaping machine, and in many cases—where there is not enough work for a machine of each kind, it will save the cost of a shaper, as for instance, in many kinds of die-work. It is a machine capable of doing very heavy, as well as small, light work

The table on the 5 ft. planer (subject of illustration) weighs 800 lbs , and reverses inside ½ inch. The table of 3½ ft. planer weighs 500 lbs., and reverses in ⅝ inch. This shows a very powerful movement in the reversing-gear, and the extreme simplicity of the device, and the slight liability to any wear to impair its action, are very strong points in its favor. We are informed that many of these planers have been in constant service for nearly six years, by some of the largest and busiest manufacturing concerns in the country, who speak in the highest terms of praise of the manner in which they do their work. The Hendey Machine Company pride themselves (we think justly) in doing their work well.

A company has been formed in Putnam, Conn., with a capital of $100,000, to manufacture tools and machinery. It is to be called the Empire Machine Company.



NEW POWER PLANER.

Exceptions Taken to Engineering Popularized.

Editors American Machinist:

The desire expressed by the author of "Engineering Popularized," viz.: "to wake up a little discussion," seems likely to be in a measure satisfied; although the character, reflections and results of the controversy may not be particularly satisfactory to said author "and others."

An unprejudiced jury would be likely to decide, from the evidence, that the gentleman from Philadelphia was a trifle personal in his remarks as they appeared in March number, and not very much to the point, unless he is laboring for the suppression of "technical slang," with which "E. P." is rather heavily loaded.

The author of the articles must be credited with being sincere in his efforts towards placing the truth (as it appears to himself) before the class he ostensibly aims to instruct. After according him justice to that extent, the first step in discussion is to mention that said articles seem rather vague, giving one the impression that the author is slightly befogged in his own researches after truth.

He asserts, practically, that the Mariotte curve is so far improved on, as to be no longer an accurate basis of comparison for indicator diagrams; in support of which view of the case, he presents in March number a very elaborate diagram, the very sight of which would be apt to puzzle a large majority of those he proposes to enlighten, and would lead one to imagine the author had formed very "expanded" ideas of heat and steam.

If the gentleman supposes that steam can be expanded within a metal cylinder, and with a pressure varying through several atmospheres, and still have "no transmission" of heat to and from the steam, we need feel no surprise at whatever "curve" the next article may develop. The basis of the argument would seem to be "cylinder efficiency," that is: the operation of piston and valve gear is treated to a great extent independently of every thing else, the fact being apparently ignored, that if engine was supplied with steam heavily charged with moisture, it would be somewhat difficult to determine character of diagram taken from same cylinder when comparatively dry steam was used.

"Actual" diagram in March number is supposed to have been taken from a "first-class" engine, but of what type is not mentioned; it (diagram) presents characteristics of automatic cut-off, and in fact proclaims pretty plainly the name of engine builder; allowing it to be automatic cut-off, with steam pipe and parts of *almost* sufficient capacity, the terminal pressure is too high to satisfy good practical requirements, to say nothing of theoretical ones, even if steam line was continued horizontal to point "A," (see diagram) and cut-off was theoretically perfect.

If cut-off valve leaked, expansion is worthless for theoretical comparisons; if it did not leak, then the steam unquestionably contained water *largely* in excess of saturation due to pressure; in the latter case, discrepancies are charged to engine that should be accounted for elsewhere. The Mariotte curve is exhibited by dotted lines in accompanying diagram, and it will be observed that its terminal pressure is considerably below that of actual curve; the adiabatic terminal would be still lower.

Dry saturated steam is not a perfect gas; heat being one of its ingredients it cannot be cooled without suffering a change in composition. Air at a tem. of 300° Far. could be cooled 100°, and the relative volumes of oxygen and nitrogen would remain the same, but steam so cooled would precipitate the water due to heat lost, and the character of vapor would be quite different. Superheated steam however, possesses some of the qualities of perfect gas, and may be cooled down to temperature due to saturated pressure without suffering change; the "super" or extra heat would probably expand steam in a manner similar to that of air or other gas so heated.

The purely theoretical operation of saturated dry steam, expanding in engine cylinder is entirely prevented by natural laws of radiation and absorption; during expansion steam simply converts heat (which is a mode of motion) into mechanical equivalent of work (which is a form of heat); its "force of displacement" having entirely ceased when cut-off valve closed the steam suffers condensation to extent of heat converted. Now, if no transmission of heat took place at end of stroke, cylinder would contain an enlarged volume of steam at temperature due to terminate pressure, and would maintain temperature it had when cut-off took place.

The total units of heat in steam would be decreased by amount represented by work done, and there would be present water set free by expansion.

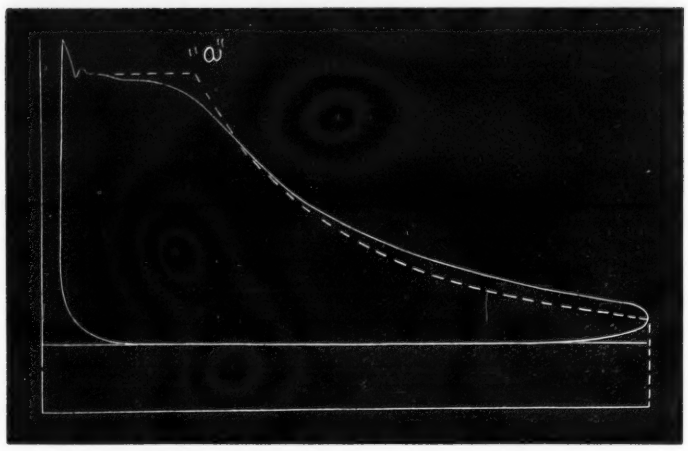
The curve formed by above expansion would be somewhat below that of Mariotte for same point of cut-off.

But expansion of steam in iron cylinders, entails something more than mere enlargement of volume, and the nearest "theopractical" approach that could be made to the extreme theoretical performance, would be the loss of just heat enough (by the iron) to re-evaporate precipitated water; curve formed by this operation would be a medium between that of Mariotte and the "extreme curve," being probably the one denominated "adiabatic" by our author.

Any water in excess of that released by expansion, would, *if evaporated*, carry terminal up to, or above Mariotte terminal, and after all water was evaporated, steam would become super-heated, no means having as yet been devised for limiting internal radiation.

Some experimenting with internally protected cylinders was carried on in New York some years ago, by an eminent engineer of that city, for the purpose probably of ascertaining to what extent internal radiation could be prevented, and if possible reduce the actual consumption of water to quantity indicated by a perfect diagram.

Would our author be kind enough to mention what build of engines is troubled with leaky valves to extent he sets forth; it is a serious reflection on machinists and their tools, to assert that 70 per cent. of their efforts at valve making is a failure There are several engines in this neighborhood, the



valve faces of which are not exactly "flat" surfaces either, that have exhibited no inclination to leak even when new, and for the simple reason that they were well made on good tools, as the "tool marks" become less and less discernable by wear of faces, their uniformity is all the more apparent.

A steam valve of proportions stated in April number, with laps of only $\frac{3}{32}$" is a prenomenon that should never be seen, and indeed, never be mentioned in any rational article on "engineering;" when such a curiosity *is* met with, the best thing to do is to box up the indicator until that "grand good" engine is "re-constructed" on a more "solid" basis of comparison.

The general tone of "E. P." in the last MACHINIST in particular, gives rise to a faint suspicion that the author of articles in view, is slightly interested in a certain type of automatic engine, which, taking steam as it does through an "exhaust jacket," would be particularly exposed to those troubles of re-evaporation he so pointedly endeavors to discountenance.

Respectfully yours,

CHAS. A. HAGUE.

CHICAGO, May 5th, 1879.

Improvement in Slide-Rest.

L. F. LYNE, M. E.

It has always seemed very strange to us that in nearly all the engine lathes built, there is a very essential point overlooked, and one that affects very materially the quality and quantity of the work done by them. We would remark at the commencement, that we are not vending a patent article, and our only object is to point out what we believe to be a serious and common defect, hoping that it will be remedied by all builders who may read this article, if they have not done so already, thereby increasing the value and capacity of their lathes.

By referring to the cut, we will proceed to demonstrate our ideas. A represents the slide-rest, to which is attached the tool-post, represented with a boring tool E in position; B represents a section of carriage of the lathe.

Now, in order to prevent lost motion and to adjust the slide-rest, so that it will move tight or loose, there is provided a gib or strip of metal, C, which is pressed against the slide by means of the screws D.

In nearly all lathes built, this appliance is placed on the right side of the slide, that is to stand facing the lathe. We have repeatedly asked the question, Why is this appliance put on the right side of the slide? and the answer invariably is, Because the screws may be tightened better—which is, in reality, no reason compared to the difficulties which appear in the practical use of the lathe, and which we will mention in their order.

It will be noticed, in using a long boring tool, like the one represented in the cut E, when the tool just begins to enter the hole, that it has a tendency to tip the tool-post towards the face-plate, and if the finger is placed upon the rest where it slides upon the carriage at D, it will be found that there is an opening, which depends upon the amount of lost motion in the slide-rest, and if in taking the first cut through a hole the tool cuts only on one side, this opening and closing will become more apparent.

To prevent this, the workman often sets up the screws D so tight that it is almost impossible to move the rest, and yet after taking a rough cut through a hole, it will have worked itself loose.

This is owing to the fact that all the strain comes upon the sharp points of the screws D, and produces a sort of rolling motion across those points which will very soon loosen them.

Another point is, that in order to insert the gib C, the metal has to be cut away so that the slide-rest is made the weakest at the place where it ought to be the strongest, and when the screws D are set up they make an opening between the gib and the slide-rest which increases as the gib wears away.

In the place of the gib, some builders use a taper wedge, adjusted by means of a screw at the large end, which is a little better, yet the same difficulties appear, though not as serious. Believing that the foregoing illustrations are sufficient, and, as every first-class lathe hand will testify, are no exaggeration we would say, that to remedy these evils all that is necessary is to put the gib on the left side, or towards the face-place, represented by the dotted lines at F.

By this improvement, the tool has not so much leverage on the slide-rest, the bearing is more solid; by the addition of the thickness of the gib to the stock on the slide-rest, it is made very rigid.

It will also be found that instead of the rolling motion on the ends of the screws, and the loosening of the same, the bearing comes square against the ends, as there is no tendency to lift it, and the strain is always downwards.

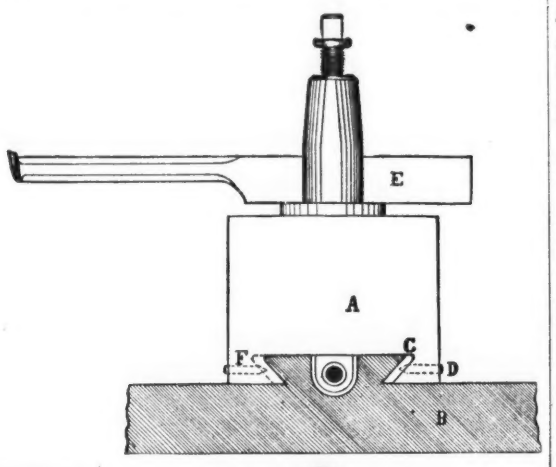
We are convinced, from our own experience and that of others, that this improvement should be adopted in all engine lathes, as it is simple, plain, does not add to the cost of the tool, and is not *patented*.

While there are many good arguments in favor of it, we have never heard one maintained against it.

Improved Hollow Spindle Screw-Cutting Lathe.

The accompanying cut illustrates an improved screw-cutting lathe manufactured by Messrs. Bancroft & Co., which has all the latest conveniences of large engine lathes, and for style and finish takes a high rank. It weighs 375 lbs., is made of the best materials, and thorough in every respect. The bed is 42 inches long, and has double V's for carriage and tail stock. It swings 10 inches over bed, 6 inches over carriage, 24 inches between centers. The spindles are steel, with ½-in. hole through head spindle. The gears that are furnished with the lathe will cut either right or left hand screws from 5 to 48 threads to the inch, and still finer threads by compounding. The carriage has a screw-stop for screw-cutting. A rack and pinion for moving by hand, and a split nut operated by a lever to throw it into gear with the leading screw. The head-stock has an attachment for reversing the motion of the carriage, and the tail-stock is so arranged that it can be set over for turning tapers, &c. The foot-motion is balanced to improve the running and to gain power. The crank and treadle are adjustable, and the shaft has swivel bearings.

For further information address the manufacturers' agent, Frasse & Co., 62 Chatham Street, New York.



Engineering Popularized.

No. V.

Messrs. Editors:

The discussion of the condensation of steam in the cylinder, as considered in the last number, leads up at once to the practical question of the proper size of engines for the work to be done; for we have seen that the internal losses become much greater—absolutely as well as relatively, to the power developed in proportion as the cut-off is shortened—in which statement I must not be misunderstood. I don't know that I can bring out the idea any more clearly than to borrow, at once, with some modifications, a diagram first determined by Prof. W. P. Trowbridge. In Fig. 1, let the distance, 20 N, represent the stroke. The vertical ordinates *aa,' bb'*, etc, represent the number of pounds of water consumed per hour in the shape of steam for each H. P. developed. The vertical scale is 16 lbs. of water per inch, and the zero line, which, for the sake of space is not shown, is supposed to be 1¼ inches below the 20 lb. line, which is the lowest line shown in the cut. Let me premise that this diagram is not a theoretical one, and is not even based on the indicator card, but is deduced from actual experiments with an engine, the water being the measured feed-water pumped into the boilers. The results, therefore, are thoroughly practical, and it will be readily understood that the same diagram shows, on an appropriate scale, the lbs. *coal* required for H. P. per hour. Thus, if your boiler evaporates 8 lbs. water per lb. coal, dividing the water found by 8 gives the coal required. Now for the explanation: Suppose that the steam follows the full stroke to N. The ordinate *N. n.* shows that the water required to be evaporated is 42 lbs. per H. P. per hour—say 5¼ lbs. coal. If steam is cut off at $a = \frac{3}{4}$ stroke, $aa' = 35$ lbs water are required. With cut off at $b = \frac{1}{2}$ stroke, 29 lbs. are required; at $\frac{4}{10}$, 27 lbs.; at $\frac{3}{10}$, 25 lbs., and one might naturally suppose, that the rate of gain having been pretty uniform with the increase of expansion so far, we should continue to derive increased benefit from still earlier cut-offs to an indefinite degree. Not so, however. By cutting off at ⅓ we only improve by 1 lb. of water, having got down to nearly 24 lbs. or 3 lbs. of coal, and at this point we seem to touch bottom. Cutting off at $\frac{1}{10}$ we find we are losing ground rapidly, 30 lbs. now being required; at $\frac{1}{20}$, 36 lbs., and so on. So that we have actually suffered as much in shortening our cut-off from *e* to *g*, over $\frac{3}{20}$ of the stroke, as we have gained in shortening it from *a* to *e*, a range of $\frac{3}{5}$ of the stroke. This extremely *rapid* loss which takes place after passing the point of greatest economy, is due—assuming tight valves—almost entirely to this internal condensation that we have been talking about. The practical or net economy may be considered as the joint result of two opposing conditions, which it may do to represent by the extended curves *e' x* and *e' y*. That is, commencing with steam following full stroke, the gain from shortening the cut-off, as shown by the curve *n e'*, is much greater than the increasing internal losses at the same time taking place, and shown by the curve *e' x*—until at, say ⅛ cut-off, the gain and loss balance. With earlier cuts, the curve of loss *g' e' x* becomes predominant, very much overbalancing the gain from expansion purely, which gain we may suppose to be still continuing according to the curve *b' e' y*.

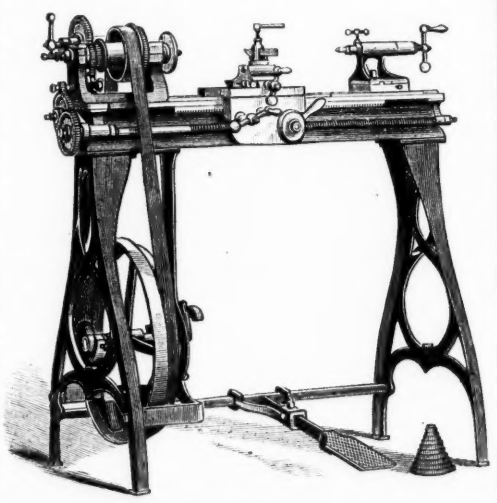
It must by no means be understood that a cut-off of ⅛ is the point of maximum economy, regardless of conditions. The point of maximum economy, as well as the absolute consumption, varies constantly with the pressure of the steam—its condition as to dryness and super-heat—the proportion, size, speed and general design of the engine, etc. The particular curve here shown is about the best performance attainable with our most perfectly designed automatic cut-off engines, of 20 inch bore and upwards, with a stroke not longer than twice the bore, and a piston travel of from 600 to 800 feet per minute. This particular curve is laid down from steam at 80 lbs. pressure, and dry, but not appreciably superheated. With steam at 60 lbs. pressure, the corresponding curve of economy *m n* would be of the same nature, but about 5 lbs. of water higher, and its point of maximum economy somewhat later, say about ¼ stroke. With still lower pressures the consumption of water and coal is still greater, and in an increasing ratio. The effect of a long stroke and a slow piston speed, is also to injure the economy and raise the curve. The effect of super-heating is not so definitely settled; but it is certain that properly used, it is of great benefit, its general effect being to lower the curve and throw the point of maximum economy in the direction of still earlier cut offs.

Now the lesson of this diagram is very plain and practical, and it is this: Select the size of your engine (and I shall have something to say bye-and-bye, as to what "size" in an engine means), so that the average fluctuations of its load shall be over a range of cut-off corresponding to the lowest portion of the economy curve, say from *f'* to *d'*, bearing in mind that there is much less danger of loss from a moderately heavy load running, out as far even as ⅓ cut off, than from an engine so large as to necessitate a cut-off somewhere from *g'* to *f'*. Indeed, one of our best authorities asserts that the earliest cut-off for best economy should not be less than ¼ stroke, and I am very far from desiring to dispute it. So, having in mind always the future requirements of the purchaser from increase of business, let me make the strong appeal—*don't get your engine too large.*

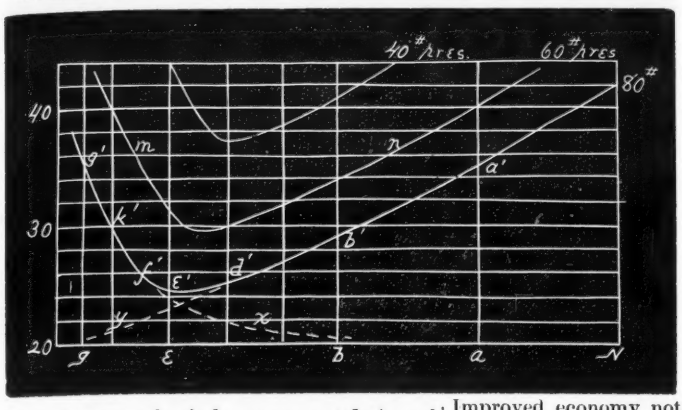
There is nothing for which I have so great a professional horror, for I have seen such piles of good dollars wasted in buying big engines, only to waste other piles of good dollars in running them. Why, it was only a few months ago that I replaced a 16×30 by a little 6×14, and had to slow it down at that, and yet it is doing the same work exactly on a third of a ton less coal a day.

But the man that builds your engine says confidentially, and of course with a profound disregard of his own pecuniary interests, "Oh, better get enough engine while you are about it! great deal cheaper to run a big engine, you know!" And so you buy it, and pay for it—and keep paying for it.

Well, naturally you ask: "How am I going to know what size I *do* want?" Well, if you haven't got confidence enough in your builder, it will pay you roundly to call in some third party. Here is the way I should go at it—disclaiming for the sake of Mr.



IMPROVED SCREW CUTTING LATHE.



Roper's peace of mind, any covert design of fishing for a job through these columns:—A has got an 18×42, and has trouble with it—no end; can't hold steam above 50 lbs., and can't run over two-thirds of his mill at that. Gets mad one day, and makes up his mind to yank out the whole kit, and get power enough in this time if he has to mortgage the farm. Is going to have a 24×60 as a matter of course—and another boiler too, on the principle that if three won't run him, four will. Gets bids from X, Y, and Z—average say, $6,000—besides new foundations and general upsetment. But being inspired by guardian angel, sends for Humble Servant. H. S., being a man of business, descends from allegory and gets to work.

I find the engine running 60 revolutions—when she can—and driving to a jack-shaft at 125 turns; water consumption by card, 35 lbs. To get at the requirements as to power, the engine not being able to handle all at once, I indicate each floor separately, subtract from each card the friction diagram taken from the engine alone and, adding up the net results, find a total of 90 H. P., which A thinks he would like to make 120 H P., to come and go on, but admits that much of the time he doesn't want over 75 H. P. Have noticed that what with low steam, and small passages, and some back pressure, and one thing and another, the heaviest *m. e. p.* on any single card was less than 20 lbs. Boilers, sound and well set, and insured to cary 80 lbs. Problem—to develop an average of say 100 H. P., range from 75 to 130 H. P., for least outlay, and with best economy; conditions, 80 lbs. steam, and speed at will. I also notice that A's foundations are good, and I would like to save them.

So I proceed to "figger."

With steam at 80 lbs, I can rely on about 35 lbs. as the best average *m. e. p.* I should like to run say from 500 to 600 ft. per minute. H. P. $= \frac{\text{area} \times \text{piston speed} \times m.e.p.}{33000}$

and conversely area $=$

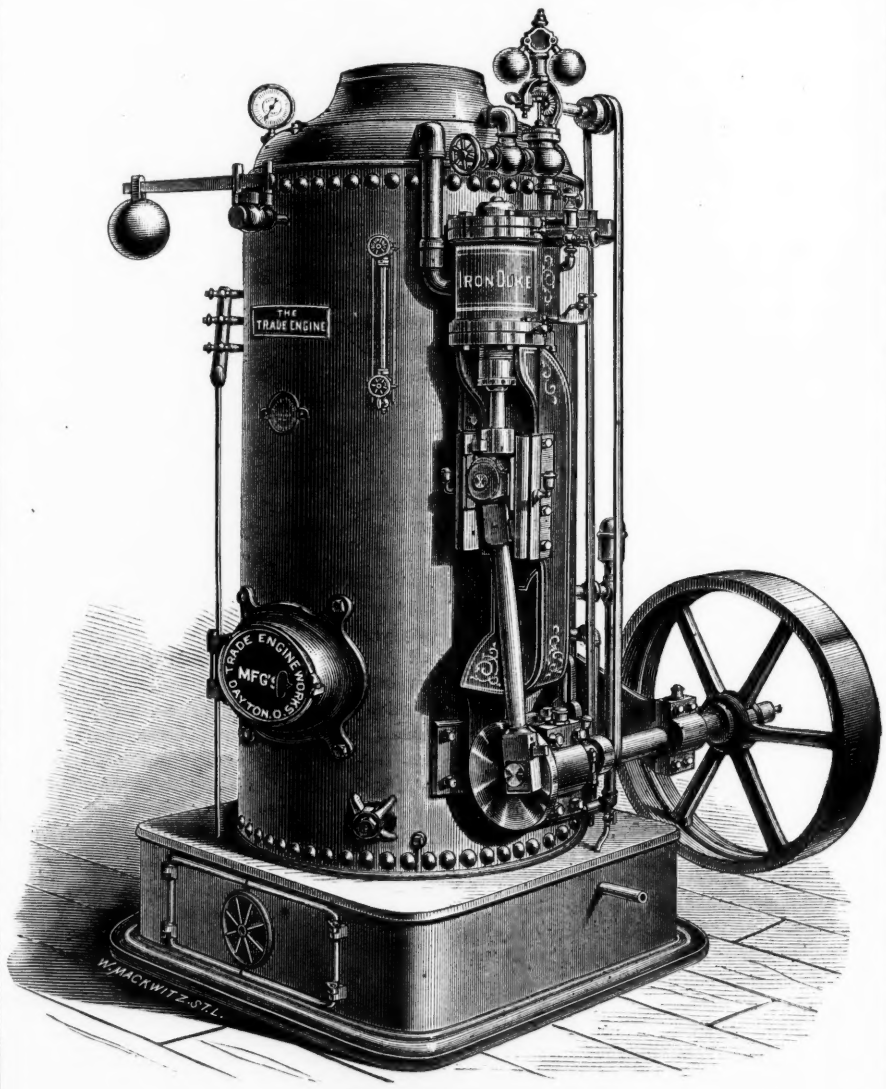
$$\frac{\text{H. P.} \times 33000}{p.s. \times m.e.p.} = \frac{100 \times 33000}{550 \times 35}$$

$=$ 171 sq. in as the required area of piston. A 15-inch piston, having 176 sq. in. area is just about the thing, so I pitch upon a 15×30, which at 550 ft will run 110 revolutions—or even a 16×32 at 95 would'nt be so very far amiss, though I shouldn't like it.

75 H. P., being $\frac{3}{4}$ of 100 H. P., would require $\frac{3}{4} \times 35 = 26$ lbs. *m. e. p.*, corresponding to $\frac{3}{20}$th cut-off. 130 H. P. calls for $1\frac{3}{10} \times 35 = 45$ lbs. *m e. p.*—a little over $\frac{1}{2}$ cut, while 35 lbs. *m e. p.* corresponds to $\frac{1}{8}$th cut. Referring now to my economy curve, I find my range of work will fall between *f'* and *d'*, so that my engine is rather too large for real fine economy after all, and if A wasn't so nervous about his engine being too small, I should certainly recommend 14×28, which would bring me on to a better part of the curve, from *e'* to a little beyond *d'*, where there would be less danger from extremes of load in either direction. But it also occurs to me that an engine direct-connected to the jack-shaft, and running 125 rev. would be a nice plant, on which basis I again "figger," and find my 14×28 is now lots big enough, and to spare. So I make my report, and if A is conservative he takes the 15×30, and if he is progressive he takes the 14×28 direct-connected. In the first case I save the cost of a new foundation, and in the second I save on the cost of a smaller engine, and in both cases, since my engines use $\frac{1}{3}$d less steam, I am able to dispense with the proposed new boiler altogether. Now "figger" a little yourself.

Estimate as propose by X, Y, and Z.	$6,000
Estimate as adopted....	2,500
Saved on outlay	$3,500
Improved economy not less than 1½ lbs. coal per H. P. per hour, equal at 100 H. P. to 234 tons at $4 equal to $936 per annum, being the interest at 6 per cent. on.....	$15,600
Net total value of Humble Servant.....	$19,100

WM. LEE CHURCH.



THE TRADE ENGINE.

Small Steam Engines.

BY STEPHEN ROPER, ENGINEER.

The small steam engine, to take the place of hand power, horse power, or even ox power, so commonly employed in the different countries of Europe for light manufacturing purposes, is peculiarly an American idea. With that inventive genius, which seems to be inherent in Americans, they have adapted the steam engine to a great variety of purposes, by which the cost of production has been greatly reduced. One of the greatest drawbacks heretofore offered to the general introduction of small steam power, has been due to the manufacturers of this class of machines, who seemed to think that, because an engine was small, it might be constructed of inferior material and in the most bungling manner. As a result, many of the small engines offered for sale *were hardly* entitled to the name of steam engine, as, instead of being handy, profitable, and convenient, they soon became a source of waste and annoyance. Within the past few years, however, decided improvements have been made in the design, workmanship and finish of small steam engines, many of them keeping pace with the best large engines in the country, among which attention may be called to the one under review.

Fig. 1 represents the "Trade Engine," manufactured by F. M. Riegel & Co., successors to Herrman Herchelrode Manufacturing Co., of Dayton, Ohio, which, by its excellent performance, is fast winning its way to public favor with engineers and steam users. The boiler is an upright tubular, with circular combustion chamber resting on a square cast-iron base. The smoke-box is inverted and covered with a hinged bonnet, which admits of easy access to the tubes for either cleaning or repairing. The lower cylinder-head, bed-plate, and recesses for the pillow-block bearings, are all cast in one piece, thus securing a rigid and substantial housing to which to attach all the other sliding and revolving parts of the engine. The bed-plate, or saddle-piece, is attached to the boiler at the top and bottom by means of tap-bolts, and, in consequence of being made hollow on the inner side, prevents the possibility of any of the parts becoming overheated.

This is claimed to be a decided advantage in point of economy. The cylinder and steam chest are cast separate from the bed-plate, as are also the guides, which facilitates the renewal, repairs, or adjustment of these parts, and, as all the parts are made to gauges, and are interchangeable, the cylinder, steam chest, cross-head and guides may be removed, repaired, or renewed as the case may be, without interference with, or derangement of, any of the other parts.

The cross-head is of a peculiar design, affording ample rubbing surface, and preventing the possibility of heating or rapid wear. The guides are V shaped, are planed and fitted on to the bed-plate, and are so arranged that it is impossible for them to get out of line with the axis of the cylinder. The connecting rods are made of the finest quality of wrought iron, and the stub and boxes of the best machine brass, and are furnished with a key, gib and strap at the cross-head end, and with a key and draw-bolt similar to those used on the main-rods of locomotives at the crank end, furnishing a very safe, convenient, and permanent means of adjustment. The gibs, or shoes, on the cross head guides are made of brass, and are provided with very convenient means of adjustment for taking up the wear, etc. The valve is the ordinary slide, with sufficient lap to cut off steam at any desired point, according to circumstances, and the governor is one that has been proved by experience to be peculiarly adapted to these engines. The pillow-block or main bearings are lined with Babbet metal, and are furnished with brass cheek-pieces and set-screws for the purpose of taking up the lost motion. The connection between the eccentric and valve-rods is made by a strap-joint, with a gib and key, and what is termed a spade-handle, which forms a very convenient arrangement for taking up the wear. The crank is of the disc pattern, and accurately balanced, insuring smoothness of motion in the running gear. The driving pulleys are turned on the face and sides. The wrist, crank-pins, piston, and valve-rods are all made of steel, and thoroughly fitted; these engines are so designed as to obviate the vibration due to the push and pull of the piston, which affects all small engines, when running at high piston speed; another very valuable feature of them is, that when employed for agricultural purposes, they are furnished with a spark arrester, which is a positive security against fire.

The "Trade Engines" are made for service, and have the reputation of being very durable, efficient and economical; and, in consequence of being made of good material and well constructed, they require very little care and can be managed by any person of ordinary intelligence.

A Peculiar Circular.

The preparation of circulars and business announcements often develope a great deal of talent. In such cases it is talent applied to practical advantage and generally yields a good return for the venture. A circular or advertisement bunglingly prepared is likely to produce anything but the result intended by the writer. The value of printed business matter depends not alone upon the number of people who read it, but also upon the kind of impression it gives the reader. The circular we give below is a good example of alliteration forming a striking kind of publication. The engraving of the pump itself is in the form of the letter P.

PROUTY'S PEERLESS PRESSURE PUMP PROSPECTUS.

People Purchasing Pumps Please Peruse.

(Patent Procured 10-29-1878).

Prouty's Peerless Pressure Pump Possesses Purely Practical Principles

Prouty's Peerless Pressure Pump Perfectly Pleases Particular People!

Particular People Preferring Prouty's Peerless Pressure Pump Proves Pretty Plainly Perceptible Perfection, Practicability, Paramount, Prepollence, Popularity!

Prudent People Purchase Prouty's Peerless Pressure Pump!

Puny People Prefer Playing Prouty's Peerless Plural Position Pressure Pump!

Prouty's Peerless Pressure Pump Proves Perfect, Positive, Portable, Powerful, Practical, Pleasing, Popular.

People Pronounce Prouty's Peerless Pressure Pump Preferable Prepollent, Priceless.

Prouty's Popular Prices Please Parsimonious People!

Perspicuous Placards (Plainly Proclaiming Peculiarities Prouty's Peerless Pressure Pump Possesses) Promptly Posted Petitioners, Postage Pre-Paid.

A. B. PROUTY, Proprietor,

Prouty's Patent Procured Peerless Pressure Pump!

Worcester, Mass.

Postcript. Please Preserve Prouty's Peerless Pressure Pump Prospectus!

Messrs. Wallace & Sons, Ansonia, Conn., write in reference to the Jarvis furnace which they have lately placed under six Harrison. "It gives us good satisfaction, making our six boilers equal to seven on old style setting. We are burning successfully *without the use of blowers*, a mixture of five tons screenings to one ton of soft coal."

AMERICAN MACHINIST

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Inside pages, 20c. per line, (12 lines one inch.)

EUROPEAN AGENCY.

The International News Company, 11 Bouverie St., Fleet St., London, will receive and forward subscriptions and advertisements on our regular terms.

EDITORIAL ANNOUNCEMENT.

☞ *Positively we will neither publish anything in our reading columns for pay or in consideration of advertising patronage. Those who wish to recommend their wares to our readers can do so as fully as they choose in our advertising columns, but our editorial opinions are not for sale. We give no premiums to secure either subscribers or advertisers.*

☞ *We are not engaged in procuring patent rights, or in selling machinery; nor have we any pet scheme to advance, or hobby to ride.*

☞ *We invite correspondence from practical machinists, engineers, inventors, draughtsmen, and all those specially interested in the occupations we represent, on subjects pertaining to machinery.*

NEW YORK, MAY 15, 1879.

Official Engineering.

Government work, especially mechanical work, always costs much more than that done by private enterprise. The greater number of persons who share in the profits (both direct and indirect), of public work probably enhances its cost. When contracts are let to private concerns by municipal authorities the final cost of many jobs is much greater than if done on private account, often two or three times as large. Debts have been piled up by cities and towns, by extravagance and recklessness in letting mechanical contracts and tacking unnecessary extras thereto, which are perpetually drawing blisters in the form of interest upon all taxable property in the corporate limits. So heavily has manufacturing property been assessed in most large cities to pay the inordinate expenses of official engineering that establishments of productive industry are driven to seek sites outside of municipalities, and pay extra freights on their goods going to market, and on the transit of their supplies rather than exhaust profits in paying taxes. The industries that can not well leave the cities, are, therefore, more heavily burdened. Mechanical jobs are the most profitable to those having the letting and oversight of official contracts because such a small proportion of citizens and taxpayers are mechanical engineers, and therefore competent to point out clearly the excessive expenditure. Official engineers make their statements so plausible that about nineteen out of every twenty citizens are unable to controvert them. As no formidable opposition arises the jobs are executed and the money paid. Where is the remedy? We are told on one hand that the press may be relied upon to expose official extravagances and jobbery in manipulating mechanical contracts. So it should be, but as a rule editors are not mechanical engineers, nor do they employ experts of that profession, and while the press is the tool that can be used to unearth to public notice schemes for official peculation, it should be used by those who are skillful in laying open mechanical costs and plans. All active engineers living in cities should make some effort to examine closely the letting of municipal contracts for mechanical work. If a secret division of spoils seems to be looming up let them sound the notes of warning through the press. When city buildings are to be heated by steam, or water-works machinery to be purchased, proposals are published, bids opened and considered, and frequently the lowest offers rejected for reasons which seem adequate to most citizens, because they are not mechanical engineers. If those citizens who possess the technical knowledge and practical experience to expose such wrong decisions keep silent by reason of indifference or neglect, those holding the strings of the public purse will not rest contented with a moderate moiety, but will become emboldened to proceed to greater lengths to increase their benefits. The press, as a rule, is free and untrammeled, except upon political questions. Projectors of official mechanical jobs know well its power and systematically take advantage of it. If in some matters the true public sentiment does not find expression let it be charged to the inactivity of those who are best able to call forth such expression. If private citizens of thorough mechanical ability had carefully looked into the official expenditure of money for works of engineering by municipal authorities in good season, the enormous debts that hamper the material progress of cities and villages would never have reached their present proportions. It is the duty of all mechanical engineers in a city to inquire into proposed official mechanical contracts, not to excuse themselves on the ground that "what is everybody's business is nobody's business."

Excessive Promises Upon Machinery.

It is an interesting study to read and compare the various circulars sent out by the manufacturers of machinery, engines and boilers. Some of them are written in plain English, carefully avoiding extraneous claims while presenting the peculiar merits of the article offered; others launch into the most invidious comparisons with the productions of all rival manufacturers, and assert that extraordinary and unparalleled results can be attained by using the machine whose excellencies are proclaimed therewith; others spread out magniloquent essays upon the defects, use and abuse of machinery of the kind presented, while others, still, confine the whole offering to a bungling asseveration of superiority to any and every other machine ever brought forth to do the same work. The hackneyed phrases we so often find in circulars, such as: "Warranted superior to any other in the market," "A guaranteed saving of twenty-five per cent.," "Perfection reached at last," "Will do twice the work of any other," "Friction reduced to a minimum," "Lasts longer and costs less for repairs," "Greatest economy, efficiency and durability," have become so trite as to make but little impression upon the average purchaser, yet they are profusely employed by many manufacturers in their printed announcements. The study often seems to be to present the strongest claims conceivable with a reckless disregard of truth and candor. This is not usually the case in other trades and occupations. The dry goods merchant is not accustomed to make extravagant claims when selling cloths and trimmings. If he did, his customers would forsake him. So in the jewelry, boot and shoe, hardware and provision trades, the seller must confine his statements within just bounds, or he will be called to account for misrepresentation. But when a steam engine or boiler is sought for, manufacturers can be found any day who will guarantee a clear saving of 15 to 25 per cent. in fuel over any other that comes into competition. The party making the highest guarantees not unfrequently secures the order upon the strength of his promises, which in most cases, according to our observation, *are not expected to be fully carried out*, nor, as a rule, are they so carried out. The engine or boiler probably works fairly, and does not appear to waste fuel, perhaps secures much better results than a poor one previously in use, and is paid for without further exaction. We do not wish to be understood as condemning a fair guarantee in selling machinery, but we contend that most guarantees of the nature here mentioned are not sustained, and work extensive injury to the trade. The high-sounding claims made by many a manufacturer are doubtless based upon rose-colored testimonials which he has received from admiring friends. In other words, they are sometimes self-deceived, and led to make offers which they believe to be fully warranted by the performance of the machine, when, in reality, they are not justified in so doing. When a man has bought a new machine or engine and finds it to work smoothly, he is generally inclined to give a glowing testimonial upon its great advantages, because it will serve to mark his business sagacity in making the purchase. To the manufacturer of machinery, who is about to proclaim the merits of his production, as well as to the purchaser, we commend the excellent motto of Davy Crockett, "Be sure you are right, then go ahead."

A Commendable Plan.

A large clothing house in this city lately paid each of their workmen one of the new $10 4 per-cent refunding certificates as part of their wages. We have heard of one or two other manufacturing establishments doing the same. These are examples that ought to be followed. The $10 certificates constitute an investment for those having but small means rarely offered in this or any other country. They are virtually current funds and draw interest at 4 per cent., the same as bonds into which they are convertible. Prudent workmen who have been too careful to risk their little surplus earnings in savings banks, and others who have never begun the habit of saving, find these certificates perfectly safe, convenient in case of prompt or unexpected requirements for funds, and very desirable to absorb the cash that can be placed by for a season. Workmen who are steadily employed find it difficult to procure these certificates, as the Government disposes of them sparingly and the rush to procure them is great. Proprietors of machinery establishments could procure one each for their hands by putting forth a little enterprise, and by taking that step, induce habits of saving and thrift among some mechanics who have hitherto been strangers to these qualities. We commend this plan to machine-shop owners, and will be glad to give publicity to all who carry it out.

The project to hold a great World's Fair—a mammoth exhibition of the industries of all nations, in the City of New York in 1883, seems to be taking definite shape, and if the two or three independent committees, appointed under different auspices, can be made to harmonize and co-operate we may look for the fair as a fixed enterprise. There is no good reason why New York, the metropolis of the Western Hemisphere, should not set on foot an exhibition as extensive and valuable as those of London, Paris, Vienna, or the Centennial at Philadelphia. It can be accomplished too without government aid, unlike all the other grand universal exhibitions that have heretofore been conducted.

The articles entitled "Engineeeing Popularized," by Mr. W. L. Church, which were begun in our January issue have attracted a great deal of attention from engineers in all sections of the country, as numerous letters and a steady demand for back numbers of the MACHINIST containing those articles give abundant evidence. At the outset Mr. Church desired to bring out a comparison of views by practical men, some of whom might disagree with the positions he takes, and in this month's issue we have the pleasure of presenting two reviews, one by Mr. Wm. J. Williams, of Philadelphia, and the other by Mr. Chas. A Hague, of Chicago. They will be read with iterest by the engineering fraternity. By a free discussion of the subjects touched upon much valuable practical information will be elicited.

There is one provision in the new State constitution, recently adopted in an election by the people of California, that will receive the approbation of all those favoring protection to legitimate manufacturing industries, and mechanics who depend on such for their subsistence. The letting out of convict labor by contract to private parties is entirely prohibited, and the Golden State takes the lead in refusing longer to sustain, at public expense, the opposition of prison labor to private productive enterprise. Let this reform be followed by other states, and not suffered to flag until universally adopted.

Machinists who are ambitious to advance themselves and obtain higher wages, would profit by reading and thinking over the advice given by "Chordal," on page 3. He has had a large and varied experience, and speaks whereof he knows. "Chordal" was present at the recent annual meeting of the R. R. Master Mechanics, at Cincinnati, and will have something to say about their proceedings in our next issue.

If the person signing himself Amateur, who writes from Troy, N. Y., reviewing some parts of "Engineering Popularized" will send us his name and address we will consider the question of publishing his communication. It is our rule to consign anonymous letters to the waste paper basket (except those intended for the Questions and Answers Department), but the merits of the one in question induces us to inquire for the author.

Our columns are again so crowded that we are obliged to leave out some valuable articles. There has not been an issue of the AMERICAN MACHINIST for the last six months that our space has been large enough to admit all the matter at hand that we desired to publish.

Reviews.

The Millstone, published at Indianapolis, Ind., H. Herbert Emery, editor, is an able exponent of the milling interests of the great West. It also gives much valuable information in practical science, free discussions of mechanical subjects and interesting correspondence. This paper is a 16-page illustrated monthly, subscription $1 a year. We notice by the last issue that the editor has just taken unto himself a wife, which reinforcement we trust will add to his journalistic powers.

The Blade is a new monthly, issued from 51 Liberty St., New York, W. H. McDougall, editor. Its motto is, "Set for the Defense of Industry, fair play and legitimate competition," and it gives some home thrusts to fraudulent monopolies.

There is no other great industry, the ups and downs of which so unmistakably indicate the state of business prosperity of the whole country, as does railroad enterprise. For three or four years previous to the panic of 1873 the extension of railroads and railroad traffic experienced its greatest progress, then came the reverse. The shock of the panic fell heaviest upon the business of railroads, and enterprises that were launched out full of promise fell flat. While most old roads were barely able to hold their own many new companies, and not a few old ones, were driven to the wall. The great iron and steel industries, being closely dependent upon railroad success for their own prosperity, rose and fell with the fortunes of our iron bound lines of communication. When the construction of railroads fell off, so did the general "volume of business." Now that the extension of railroad lines has received a fresh impetus, and traffic has become more remunerative, we can safely calculate upon increased activity to all legitimate business enterprises. The iron and machine industries cannot flourish while railroading languishes, and can not fail to make progress while railroading flourishes.

Inquiries in regard to Friction and Lubrication.

"A graduate of Union," and for six years a civil engineer, three of which were spent in that capacity on the Fourth Avenue Improvement, I began about a year ago the study of mechanics.

One of the first things that struck me was the plainly apparent impossibility of harmonizing the "generally accepted laws of friction," and "the means and materials used in lubrication," with "the practical working of machinery to be seen on every side."

It was rarely that I could find two engineers or machinists to agree as to what is the best material for journal bearings, or what the most desirable and economical lubricant to use.

I was in a maze of doubt on the entire subject, which was not in any degree dispelled by listening to a discourse by Prof. Thurston, before "the Master Car Builders' Association," December 20, 1877.

This lecture was illustrated, and reported very fully in the *Railroad Gazette* of January 18, 1878.

In the same number, the Editor, Mr. M. N. Forney, has an editorial on "Oil," which is really a review of Prof. Thurston's lecture. Mr. Forney commences this article by saying: "On another page will be found the very interesting lecture by Professor Thurston, delivered at the December meeting, held at the rooms of the Master Car Builders' Association, in New York.

"It will no doubt do a great deal to shed light on this little understood subject, and is one of the first attempts that we know of at formulating the knowledge which we have on this subject. Not that any pretensions were made at completeness, because the address was entirely extemporaneous, and was not the work of careful preparation. The fact is, that all the existing knowledge of this subject seems to be entirely fragmentary."

Mr. Forney makes this point: "In testing on a frictional machine there are two things that should be determined, one the endurance of the oil, that is, the number of revolutions made for a given quantity; and the other, the amount of 'the co-efficient of friction.'

"One oil may have a low co-efficient of friction, but have little endurance. Another oil may have a high co-efficient of friction, and great endurance."

And in a foot note (page 31), referring to "Table of Co-efficient of Friction," &c., (page 25), submitted by Prof. Thurston, as facts demonstrated by use of the "Thurston Testing Machine." . . . "We are inclined to believe that there must be some error in these experiments. The results are so different from those indicated by other observations that they require confirmation before being implicitly accepted."

The doubt here expressed by Mr. Forney, as to the accuracy of Prof. Thurston's tables, is not to be wondered at, if the "long-accepted theories of friction," to be found under the authority of Morin, and others who preceded him, are accepted *as true* by Mr. Forney.

It would make this article too long to be generally read if I went into a full analysis of these tables.

Enough that here we have sufficient proof if the "alleged facts" be "absolute facts" to entirely destroy the "accepted theories."

That they are "incontrovertible facts" will, I think, be fully proved by reference to subsequent discourses, trials, &c., by Prof. Thurston, Westinghouse, and Captain Galton, in England, Webber, and Higginson, of the Chicago, Burlington and Quincy Railroad, and others, which I will briefly notice before closing my series of inquiries.

Mr. Coleman Sellers, of Messrs. William Sellers & Co., certainly very good authority, in a lecture on the "Transmission of Motion," delivered at the Stevens Institute of Technology, Hoboken, Feb. 19, 1872, incidentally remarks, (page 16), "by diminishing the diameter we diminish the speed of the rubbing parts, and the tendency to heat is much increased with increase of velocity."

Again, (page 14), "Mr. Bancroft thought all boxes should be made five diameters of the shaft long, i. e., a box for a 2-inch shaft should be 10 inches long; but it has since been demonstrated that four diameters is sufficient, and that has been the practice for many years.

At present I finish this lecture by one more quotation. "With a pressure *not exceeding fifty pounds per square inch*, and oil well distributed over the surface of the box, the metal of the shaft will not touch the surface of the box, it will run on the oil used as a lubricator."

These statements of Mr. Coleman Sellers are repeated substantially on page 197 of the Catalogue of Messrs. William Sellers & Co., Machine Tools, J B. Lippincot & Co., Philadelphia, 1877.

The proportion of length of box to diameter of shaft therein stated, viz: *four diameters of box* was "the standard" of the house of William Sellers & Co., used in "the miles of shafting" they put up in the Centennial Buildings in 1876.

Per Contra—

Prof. Thurston, in Table B, page 300, Journal of the Franklin Institute, Nov. 1878, article, "New Determinations of the Co. efficients of Friction of Lubricated Journals, and on the Laws Governing such Friction, by R. H. Thurston, A. M. C. E., gives:

Speed per minute.	Pressure per Sq. inch.	Heat.	Coefficient of Friction.
30′	200 lbs.	150°	.0500
1200′	200 lbs.	150°	.0060

Here is a velocity of 30 feet increased to 1200 feet, or 400 times the velocity without *any increase of temperature*, 200 lbs. pressure per square inch in both trials, and a *decrease* of the co-efficient of friction from .0500 to .0060.

To those who are far wiser and more learned than I am I leave the reconciliation of the foregoing.

Let us look abroad to see if foreign constructive engineers have settled any of these, to me, "vexing questions."

Chief Engineer King, of the United States Navy, in his second report on "European Ships of War," &c., transmitted to the Senate by the Secretary of the Navy, January 27, 1877, page 107, gives details of "The Rover," one of a class of four vessels intended to make 17 knots per hour, and to be vastly superior to the class to which "The Shah" belongs.

This vessel, "The Shah," it will be remembered, had "the crank and main journal bearings *melted* on her trial trip," thus being like the Ericsson and the Isherwood designs, as put into "The Dictator" "The Wampanoag," &c., of our own navy, *absolutely worthless* from "mal-construction."

This vessel "The Rover," is of 3,494 tons, is to be driven 15 knots at sea. She was put on trial November, 1875, and sent to the West India Squadron immediately thereafter.

These engines were the first of their kind completed and used in the British Navy, and special interest has been taken in their performance.

They are compound and surface condensing, and belong to the type known as the horizontal return connecting-rod, and have their cross-heads working in "slipper guides." According to the contract they were to indicate 4,750 horse power.

I will not encumber your pages with further quotations this month, but request some competent "constructive engineer" to go over Chief Engineer King's report, and to give me, and *students like me*, of whom you have a great many readers, a table, or tables on which speed of surface, pressure per square inch, co-efficient of friction, &c., of the engines of this vessel, "The Rover," also of "The Pelican," which has Loftus Perkins' six cylinder compound engines working with 300 lbs. pressure of steam, and in addition thereto, his (Perkins') boat, "The Emily," working with 500 lbs. pressure of steam expanded twenty-four times, with a consumption of coal of 1 lb. per horse power per hour. And of other vessels of the English, French, Italian and other European navies and merchant marine, such as the "Iris," and "Mercury," of the English Navy, and "the White Star steam vessels," engined by Maudlay, Field & Son; The Tourville, of the French Navy; The Christoforo Columbo, of the Italian Navy, &c. With tables of this kind, we, the students, can begin to learn what friction and lubrication really mean, and we will have some basis by which to compare the work of our own constructive engineers in marine locomotive and stationary engines, and the various mechanical engines and tools that are daily brought to our notice.

We can also form some opinion, wise or unwise, as to what constitutes the vast superiority of the Corliss Pumping Engine at Pawtucket, over all of the pumping engines hitherto built in this country.

S. L. F. D.

New York, April 3d, 1879.

Business Specials.

Thirty cents a line for each insertion under this head.

Brown & Sharpe M'f'g Co., Providence, R. I., keep in stock at reduced prices Patent Cutters for the teeth of gears which can be sharpened by grinding without changing their form. All wheels of same pitch cut with them will run together correctly. Send for new catalogue.

The Pratt & Whitney Co., of Hartford, Conn., make a specialty of Cutters for the teeth of gear wheels, that are shaped entirely by machinery and will make interchangeable all gears that are cut with cutters of the same pitch.

For Drop-Forging, Packer Ratchet Drills, Lathe Dogs, Screw Plates and Dies, address The Billings & Spencer Co., Hartford, Conn.

National Steam Pump, simple, reliable and durable. Send for illustrated catalogue with reduced price list. W. E. Kelly, New Brunswick, N. J.

For Screw Cutting Engine Lathes of 14, 15, 18, and 22in. Swing. Address Star Tool Co., Providence, R. I.

W. H. Warren, Designer and Manufacturer of Special Machinery. Works, 25 Herman Street, Worcester, Mass.

Swedish iron, undisputably the best in the world, is to be found with *Charles G. Lundell*, of No. 7 Exchange Place, *Boston, Mass.*, at *lowest* market prices and of brands well known in this country. Being direct agent for the largest shipping commission house of his native country, Sweden, his facilities for offering iron for importation as well as for sales from warehouses in New York, Philadelphia, and Boston cannot be surpassed.

Questions and Answers,

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly and according to common sense methods.

(1) E. N. O., Detroit, Mich., asks: Is there any danger of getting steam too dry by superheating? A. Yes; steam when heated up to 350 degrees ceases to become a lubricator in the cylinder. There must be sufficient condensation on the surface of the cylinder to form a lubricant and prevent the rings from cutting the bore of the cylinder. We know of several cases where the cylinders were ruined, so that they had to be re-bored, on account of the steam being too dry. Superheating high for steam practically does not pay, although the advantages appear to be very great. To have a little condensation on the surface of the cylinder is the only way that large engines can be kept from cutting.

(2) X. I., Savannah, Ga., inquires: It is a common practice among engineers to haul the fire on Saturday night, either once or twice a month, and immediately open the blow-off cock. Is this the proper course to pursue in blowing off a boiler? A. No; rather than proceed in the manner you describe, it would be better to wait, say one hour, after drawing the fire, before letting out the water, for where the brick work is heavy, it will be observed that the bricks in the furnace will remain red-hot for a long time after the fire is drawn, and if the water is let out under these circumstances, the boiler will be more or less injured by the heat. In the case of a locomotive or other boiler not set in bricks it does not matter so much. Never fill a boiler with cold water immediately after blowing off.

(3) Vulcan, Jefferson City, Mo., writes: In your last issue, the question is asked: Does the water in a boiler get any hotter after it begins to boil? The answer is, No; if the steam be allowed to escape. I would like to know what would be the result if the steam were confined? A. Water begins to boil at 212 degrees.

					Fah.
At pressure	(above the atmosphere)	of	10	lbs.	240 deg.
"	"	"	20	"	259 "
"	"	"	30	"	274 "
"	"	"	50	"	298 "
"	"	"	80	"	324 "
"	"	"	100	"	338 "
"	"	"	150	"	366 "
"	"	"	200	"	388 "

(4) R. N., Philadelphia, writes: I have had many arguments with my shopmates in reference to the measurements of 1-1000th of an inch wherein they claim that it cannot be measured. Please give me some simple directions how this may be done, so as to convince the most obstinate. A. Take, for illustration, the ordinary sheet metal gauge, or micrometer calipers. The screw is cut with fifty threads to the inch, the head of which has twenty divisions on the circumference. Each division, therefore, corresponds to a longitudinal motion of 1-1000th of an inch on the part of the crew, and, consequently, one-half of one of these divisions on the head, or, in other words, if the head was divided into forty instead of twenty divisions, it would just double the delicacy of the instrument, and so on. We trust that this will be simple enough. Sir Joseph Whitworth invented an apparatus by which the ten thousandth part of an inch may be measured.

(5) W. W., Fitchburgh, Mass., asks: I would like to have you inform me in reference to the proper name of the two side tools used on engine lathes, for facing off the sides of a plate. I contend that a tool which will face off the right hand side of a piece of work, and cuts toward the face-plate, is properly a right hand side tool. Am I right? A. Yes; the tool that will do what you represent is properly right handed, not only for the reasons that you mention, but because it works right-handed with the lathe, and is so designated by tool builders. A tool cutting in the reverse direction is obviously a left hand tool.

(6) Walker, St. Paul, Minn., writes: I noticed an article in your issue of April, entitled, "Practical Hints on Leather Belting," and like it very well, all except the last paragraph, where you state that belting should be run with the flesh side to the pulley, with the hair or grain side out, it being more practical to run belts in that way, etc. I do not agree with you there, and would like to ask that—if in copying it from the circular of Mr. Anton Heim, you intend to support that sentiment or not. Please explain. A. In reference to the point upon which you take exception, we would say that we believe (judging from some experiments made on oak tanned leather belting) that there are advantages derived by running the belt with the grain side towards the pulley, namely: A strip was cut from the middle of a side of leather, (3-16 inch thick×1 inch wide) and split exactly in the center; the grain side half was then tested, which broke under a strain of 468½ lbs.; the flesh side broke under a strain of 740½ lbs., thereby proving that the strongest part of the leather was about one third through from the flesh side. Placing the grain side next to the pulley, brings the strongest part furthest away from it, and the belt will not crack when it becomes dry. With the flesh side next the pulley, we do not get over one-half the bearing, and when the belt runs with great velocity, the air gets into the hollows under it and causes it to slip. A belt will last longer run grain side to the pulley and drive from thirty per cent. to thirty-four per cent. more than the flesh side. A belt placed upon a pulley covered with leather, with grain side toward it, will drive fifty per cent. more. For further information on belting, see extract from Centennial Report of Judges of Group XX, written by Mr. Chas. E. Emery, of New York, contained in March number, 1878, of the AMERICAN MACHINIST.

(7) R. S., Richmond, Va., writes: Will you please inform me why the use of the mud drum on steam boilers has been almost if not altogether abandoned? A. Mud drums were at one time considered an advantage, but, after long experiment, it has been demonstrated that they are of no practical value. They are exceedingly dangerous, on account of rapid corrosion which takes place in them, and there are instances on record where serious accidents have happened from the explosion of mud drums. The expense of repairs and renewal is found to be really more than the benefit derived from its use.

(8) B. P., Paterson, N. J., writes: Will you please tell me the proper way to feed a boiler. A friend and Professor of Mechanical Engineering has had a duplex Worthington Pump placed so that he can raise the water in the boilers about eight inches in five minutes. What I desire to know is, if this is a proper way to use a boiler? A. A boiler should be fed no faster than the water is used. Where a boiler is fed fast, there will be a difference in temperature of 200 degrees in the same plate, and the bottom of the boiler will often fall as low as thirty-five degrees temperature, if the feed water is taken from the hydrant. Change of temperature assists corrosion. A boiler should be kept as near the same temperature as possible all the time when in operation, as it will add greatly to its durability and safety.

(9) C. F. R., Philadelphia, writes: In reading over Mr. Church's articles entitled, "Engineering Popularized," I see he frequently uses the word "cylinder efficiency." Will you please inform me through your Question-and-Answer column, what "cylinder efficiency" means? A. The meaning of the term "cylinder efficiency" was pretty fully explained in No. 3, of Mr. Church's articles, in the March number of this paper. Briefly, however, it is this: For any given pressure of steam remaining in the cylinder at the end of the stroke, at the moment of exhaust, the steam *should have performed* a certain

theoretical amount of work, measured by the mean effective pressure of a theoretical diagram, which diagram is bounded by the boiler line, the adiabatic curve, the release line, the atmospheric line, and the compression curve. Now, no engine in actual practice will develop this full amount of work, with theoretical perfection. It will only develop a *portion* of the theoretical duty. The ratio of this actual work to the theoretical is cylinder efficiency. The best engines will show about ninety-five per cent. of perfect duty, and we would then say the cylinder efficiency is ninety-five per cent.

(10) J. H. M., Worcester, Mass., says: I am desirous of constructing a small toy-steam engine, out of some metal easily fused. Is there any back number of the AMERICAN MACHINIST which will tell me how to go to work to do it. If there is, you will oblige me by letting me know, in the column of Questions and Answers, in your paper? A. Tough metal for small engines: Lead, 100 parts; antimony, 32 parts; tin, 8 parts; melts easily. From this proportion, mix any quantity that you may require.

A Model Patent.

It is not the aim of the AMERICAN MACHINIST to devote any particular attention to patent rights. So long as the Government sustains the regular weekly publication of the *Official Gazette of the U. S. Patent Office*, with all the claims and copies of drawings of every patent issued together with all trade-marks, designs, labels, patent decisions, etc., no journal conducted by private enterprise can publish a tithe of the patent information that can be obtained by subscribing to that periodical. However, when any remarkable patents come forward we are constrained to give them "something more than a passing notice." The patent of which the drawing and claims are given below dates back several years, but as a reissue has been applied for we give publicity to the rare merits of the invention. True, there is a striking similarity in the claims to those of many other mechanical inventions for which patents have been granted, but, (as with some others) the original and ingenious *combinations* constitute its surpassing value.

NEW AND INGENIOUS READY-ACTING DOG-TAIL AND GUN-BARREL ATTACHMENT, FOR SPORTING PURPOSES. INVENTED BY JOHN MACSKINEM, NEW YORK.—RE-ISSUE APPLIED FOR.

Having thus described my invention, I claim:

1. In combination the dog's tail and the extra sized trigger, and the trigger guard; also the combination of the trigger with the dog's tail; also the *whole* dog and the general application, in the manner substantially and for the purpose described.

2. In combination the *shape, size, color*, outline and general ornamentation of the dog; also the gun and trigger with their general appearance and mode of operation for the purpose herein set forth.

3. In combination the shaft or back-bone of the dog, mounted at *right* angles to the extra sized trigger; the direct and positive connection between the shaft and the trigger whereby the shaft remains at rest or nearly so while the trigger moves out of a perpendicular position to discharge the gun, substantially as set forth.

4. In combination the *horizontal supporting bed*, formed by the upper surface of the dog's back, which supports the gun against the action of gravitation, and holds it in a *horizontal position* during the operation of shooting, whereby the gun can be *held* and *carried* in a *horizontal* instead of a vertical position as heretofore; also the *horizontal* position of the *whole dog*, with the vertical reciprocating and yielding trigger, substantially as herein specified.

The steam engine works and residence of the late Lyman Wheeler, at Westfield, Mass., are offered for sale. The property is in first class condition, and is desirable for parties who wish to build small power engines. The Wheeler engine has an excellent reputation and an extended sale. The executors are Mrs. Elvina Wheeler, Westfield, and W. T. Woodward, Orange, Mass.

The Nicholson File Co., Providence, are running to full capacity, and will make a considerable enlargement of the works this spring.

MANUFACTURES

C. Whitcomb & Co., Worcester, Mass., are filling a large order for copying presses, to be shipped to Constantinople, Turkey.

E. N. Boynton Worcester, Mass., has just filled an order for bolt cutters and drills, to be shipped to New Zealand.

The Deane Steam Pump Works have removed since May 1st, from 85 Liberty St., to the large and commodious warehouse, 92 and 94 Liberty St., lately occupied by the Knowles Steam Pump Works. The growing popularity of the Deane Pump and constantly increasing sales have necessitated this removal to more extensive quarters. They will exhibit a full line of pumps in the new warerooms.

The office of the Buckeye Engine Company was changed May 1st from 87 Liberty street to room 42, Coal and Iron Exchange, corner Church and Cortlandt streets. The demand for the Buckeye engines has rendered it impossible for them to keep a stock on hand, though the works are kept running day and night. Those making inquiries in reference to the purchase of Buckeye Engines will be referred to several of them running in this city and in other localities.

P. Blaisdell & Co., Worcester, are now getting out a 24-inch wide planer from new and improved patterns, which will present some special features of merit.

The Betts Machine Company, Wilmington, Del., have purchased nearly the whole stock of patterns and drawings of the N. Y. Steam Engine Company, which gives them a large addition to their line of machinist's tools.

A company has been formed in Putman, Conn., with a capital of $100,000, to manufacture tools and machinery. It is to be called the Empire Machine Company.

The Hartford Foundry and Machine Company are building a 22″ x 48″ engine for Bradley & Hubbard Manufacturing Company, Meriden, Conn. They recently built a 14″ x 36″ engine for the Philadelphia Bank Note Company.

The Putnam Machine Company, Fitchburg, Mass, are employing 250 men on machine tools, steam engines, etc., and are increasing the force.

The Pratt & Whitney Company, Hartford, are employing 350 men, full time, with plenty of work ahead.

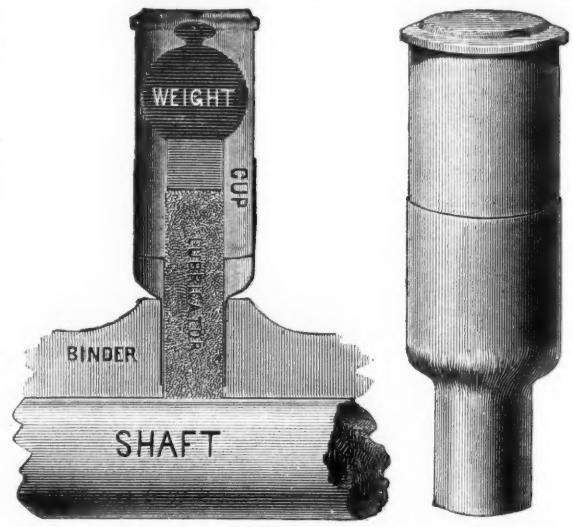
The Chester Steel Castings Company, the Chester Tube Works, the Eureka Company, and the Iron Rolling Mill are all busy—full time.

William C. Stoddard, Paterson, N. J., writes us: "We have here three large locomotive shops, and at the present time they are all doing a pretty fair trade. The Grant Works are turning out two engines a week, Danforth, Cooke & Co., the same number, and the Rogers Works about twelve a month with orders enough booked to keep a full force of hands employed all summer. The silk business was never better than it is here now. All the mills are working their full force and running over-time at that. We have about twenty silk mills in Paterson besides which there are about three hundred families in our city who have looms in their houses weaving all kinds of silk goods, such as dress goods, silk handkerchiefs and bindings. We have a steam engine works turning out Baxter, Green and Todd engines.

We have one large rolling-mill employing 300 hands night and day. The wages paid in this city are about the same as they are paying all over the country—very low, but we cannot complain as work has to be done cheap so as to secure orders for it."

A New Shaft Lubricator.

The accompanying cuts exhibit a new lubricating device for shafts and other bearings, which commends itself for simplicity, cleanliness, and regularity of action. The cup is made of zinc, in two parts, the upper part telescoping into the lower. The lubricant is a cylinder of tallow, around which paper is wrapped, holding it to the weight shown in cut. The lubricant rests directly upon the shaft, and is worn away according to the velocity of the latter, requiring to be replenished at intervals, anywhere from ten days to six months. A hole is bored through the cap or binder, just large enough to admit the lower portion of the cup. If the cup is too long, a part may be cut off. The cups can be placed at any angle required, the weight keeping the tallow pressed upon the bearing. No drip pan is required. Some hundreds of these lubricators have been in use for several months giving good satisfaction. They are evidently more economical to use than oil cups, as well as cleaner, and require less attention. The manufacturers are W. J. Faul & Co., 218 Centre street, N. Y.



Editors American Machinist:

I noticed in your last issue a paragraph entitled "An Engineer's Movement," which stated that a meeting of engineers was held in your city on the 12th inst., to discuss legislative measures for the protection of competent engineers against the rapacity and avarice of owners of steam engines and boilers, and incompetent "starters and stoppers," who are degrading the profession by working for almost any wages. As an engineer of 40 years experience, I give the move my hearty endorsement, as must all right minded people. It ought to have been commenced sooner; but the old adage holds good in this, as well as in all other cases, "better late than never." Merchants, manufacturers, butchers, bakers and milkmen hold their conventions and adopt measures to protect themselves against injustice, imposition and fraud; why not the engineers?

Engineers labor under one great disadvantage in New York as in most other cities in this country; they have no organ through which to appeal for justice to public opinion or the legislature, or law-making power of the state, nor will they ever until they encourage and support a journal through whose columns they can assert their rights and denounce their wrongs. THE AMERICAN MACHINIST is a young, enterprising journal, circulates largely, and is read by more manufacturers and owners of steam-engines than any other paper published on this continent; it is decidely an engineers' and machinists' representative organ. Let the engineers support it; they will find themselves benefited by doing so in more ways than one; they will find it brim-full of such information as every man in this country that has charge of steam-engines and boilers needs, besides its columns will be always open for them to place their grievances before the public.

Yes, Messrs. Editors; let the engineers hold a public meeting and assert their rights by every moral and legal means, without advocating a resort to strikes or any arbitrary interference between the employer and the employee, excepting what is fair and just between man and man. If they will follow the foregoing suggestions, I will not only advocate their cause to the best of my ability, but render them substantial aid otherwise.

STEPHEN ROPER,
447 No. Broad St., Philadelphia, Pa.

Machinists' and Engineers' Supplies.

Trade is fair, and there is more steadiness to values than for many months part.

The New York Twisted Drill Co. are offering a new twist drill, which is said to embrace some particular merits.

Goodnow & Wightman, 176 Washington Street, Boston, have just issued a new 100 page illustrated catalogue and price list of tools and machinists' supplies, castings and parts of models. The catalogue will be sent free to any address.

W. J. Faul & Co., 218 Centre Street, New York, manufacturers of the Positive Lubricating Cup, inform us that they have orders ahead for 2,500 cups in two weeks' time. The cups are in three sizes and are solid (zinc), at 25, 30 and 35 cents each.

The E. Horton & Son Co., Windsor Locks, Conn., have reduced the price of the Horton Lathe Chuck 30 per cent. throughout the list. These chucks are very popular in machine shops in all parts of the United States, and a large number of them are being exported.

Armstrong's Adjustable Stock and Pipe Dies has lately been offered the trade by F. Armstrong, Bridgeport, Conn. The tool is easy to work with, has great capacity, and is easily kept in working order.

Howland's Improved Lifting Jack is a tool offered by W. C. Duyckink, 50 John Street, New York. It weighs 23 lbs., and will lift 4 tons. The price is $15.

The Newark Steel Works have made arrangements to be represented in New York City by Edward Frith & Son, 241 Pearl Street. The reputation of Newark steel for tools and machinery, among those that have used it, is unexcelled by any other, either American or foreign. The material used in its manufacture is the best Swedish iron, and unusual skill and care are exercised in its manipulation.

NEWARK STEEL WORKS,
NEWARK, N. J., May 1, 1879.

DEAR SIR: For the sale of our steel, from this date, our firm will be further represented by Messrs. Edward Frith & Son, 241 Pearl street, New York. For more than 20 years Mr. Edward Frith has had the practical management of Messrs. Sanderson Bros. & Co.'s business in the United States and Canada. He is consequently familiar with the various demands of the steel trade, and his long experience enables him to correctly interpret any special orders for us which you may be willing to intrust to him.

We are of course extremely gratified to be able to report that our efforts to make decidedly first class cast steel have been rewarded by repeated and daily increasing demands. It is highly valued for tools, is extensively used at some of the largest machine shops in the country, and is unsurpassed in its adaptation for granite-rock drills and mining purposes.

We intend to maintain the high standard of excellence, uniform quality and temper, which we have attained. Our very best attention is given to the production of smooth-surface and perfectly true round machinery steel, die steel, steel for all kinds of agricultural implements, for files, skates, carriage springs, tires, sleigh shoes, and for all special purposes.

We quote lowest prices consistent with the employment of the best suitable materials, carefully treated in the manufacture, and we earnestly request the favor of a trial of our steel by those who are not as yet our correspondents.

Assuring you of our careful regard for your interest we are respectfully yours,

BENJAMIN ATHA & Co.

The Brainard Milling Machine Co., Boston, offer their Steel Bar Vise for machinists use at following prices:

1½ Inch	$ 3.00	4½ Inch	$12.00
3 "	7.00	5 "	17.00
4 "	10.50	6 "	25.00
5 " Pipe Vise with extra jaw			23.00

This is a "traversing" on both rotary and sliding vise. The front jaw is the movable one. The base or projection of the front jaw is a bar of cast steel, welded to the cast iron which gives great strength and clasitity.

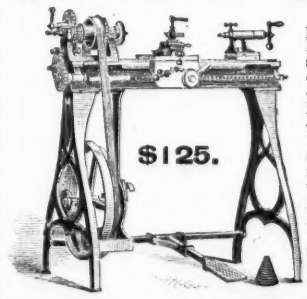
The Lewiston (Me.) Machine Works employs a force of 140 workmen, and has every available space in use. The foundry is crowded with work. Their specialty is cotton machinery.

SPECIAL BARGAIN.

Any party wishing a 48 in. x 16 ft. Planer, in perfect working order, can secure the same at a low price, by addressing

E. P. BULLARD,
14 DEY STREET, NEW YORK.

Improved Foot Power Engine Lathe.



This cut represents a new Lathe that for style and finish cannot be excelled. The length of bed is 42 in. Swings 10 in. over bed (6 in. over carriage); 24 in. between centres. It has steel spindles, with ½ inch hole through Head Spindle, and weighs 375 lbs.

It is geared to cut right or left hand threads from 5 to 48 to the inch and finer by compounding.

There is a screw stop on the carriage for screw cutting. The tail stock is arranged to turn Tapers, &c. and the foot power is balanced to improve the running and to give power.

FOR SALE BY
FRASSE & CO.
Manufacturers' Agents,
62 Chatham Street, NEW YORK.

JAMES D. FOOT

W. & K.

40 BROADWAY, NEW YORK.

SOLE AGENT FOR

Weinmann & Kearney's Hand-Cut Files.

These Files are full weight and strictly hand-cut. We make everything on Stub's Cuts and Shapes. Send for Circular. A few references by permission:

Winchester Repeating Arms Co.
The Whitin Machine Works,
Bliss & Williams.
Farrel Foundry and Machine Co.
The Singer Mf'g Co.
Smith & Wesson.

FILERS' TOOLS AND SPECIALTIES,

CONSISTING OF

PATENTED HOLDERS FOR

Surface Filing.
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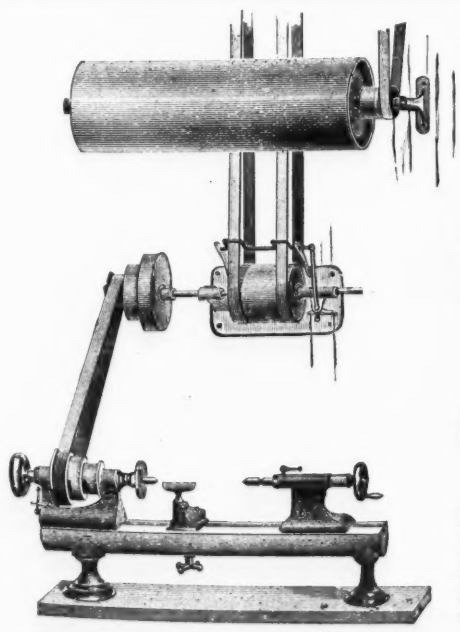

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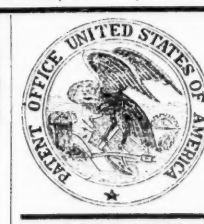

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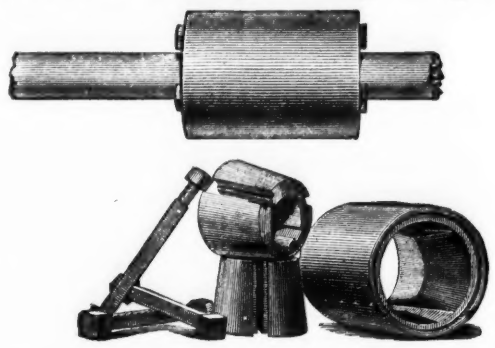

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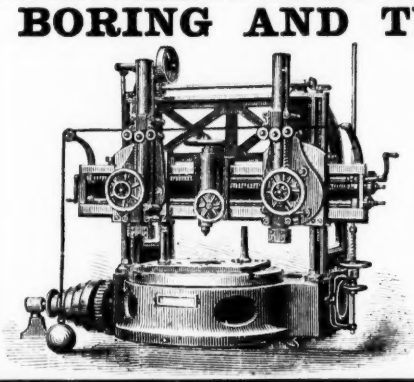

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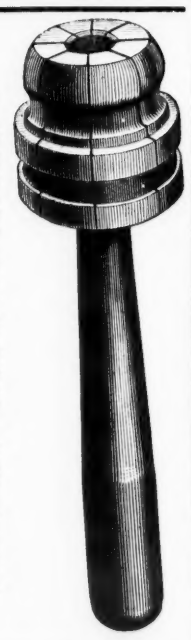

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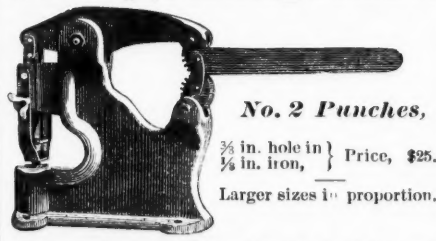

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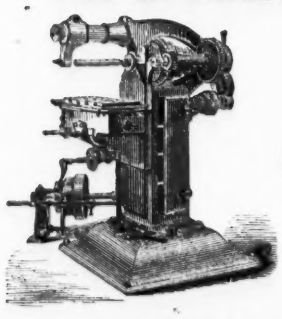

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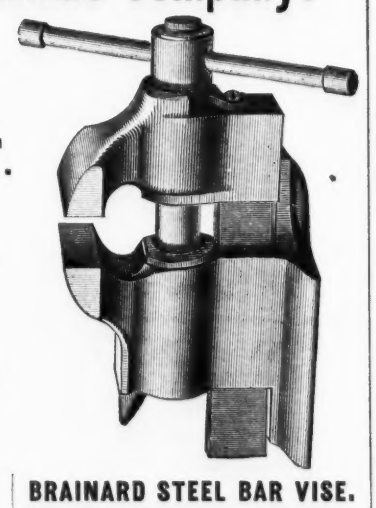

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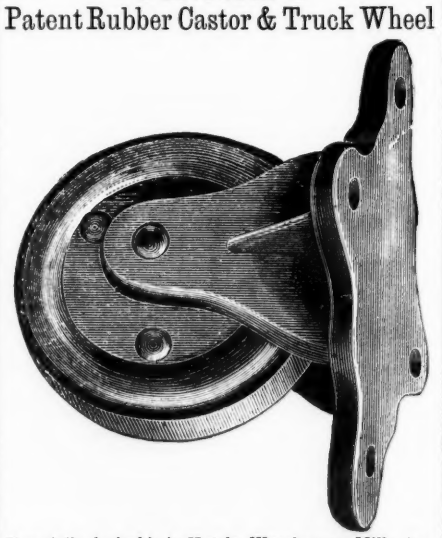

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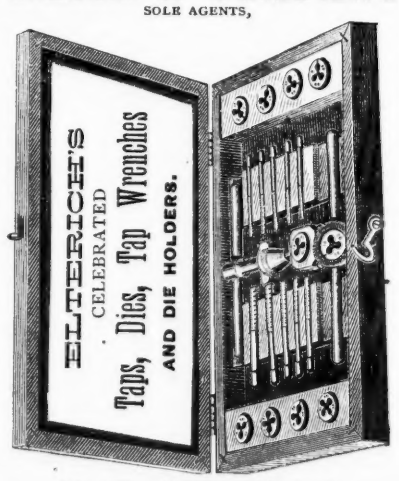

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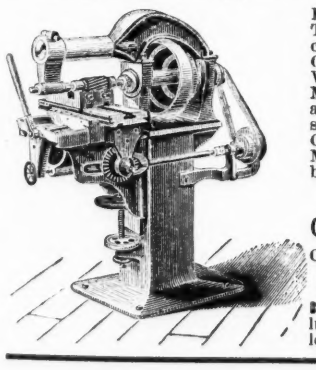

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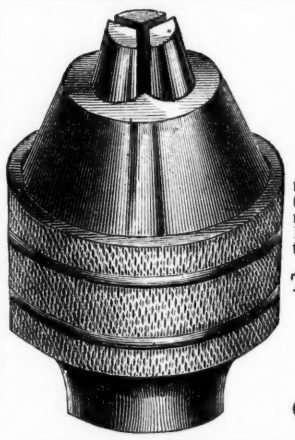

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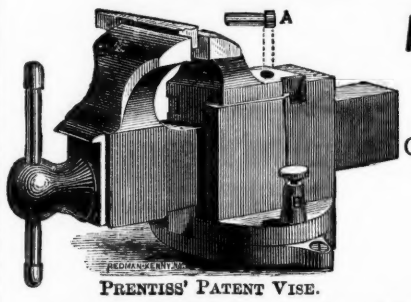

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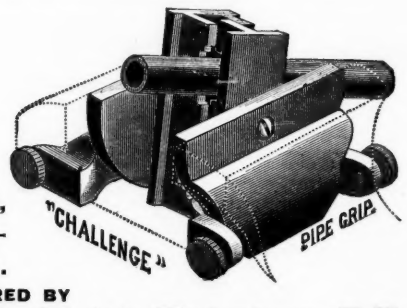

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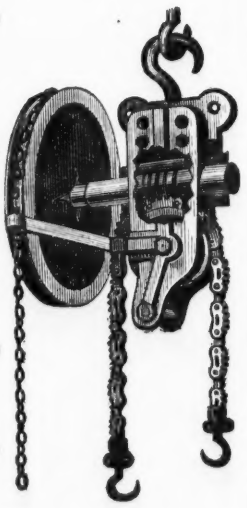

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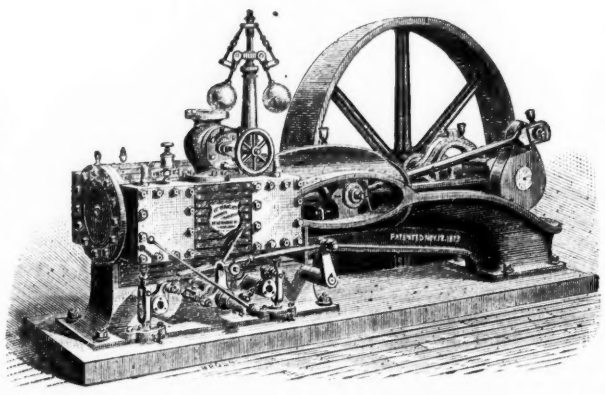

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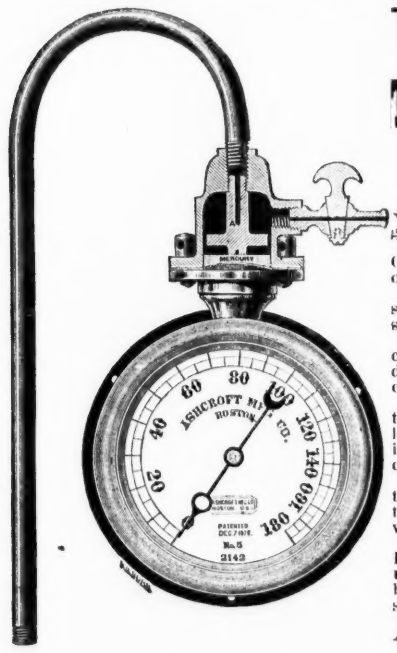

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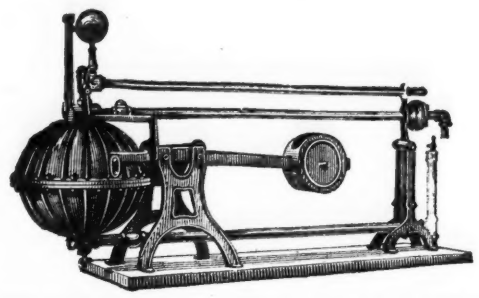

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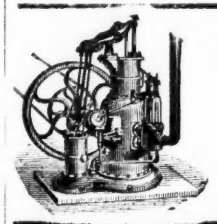

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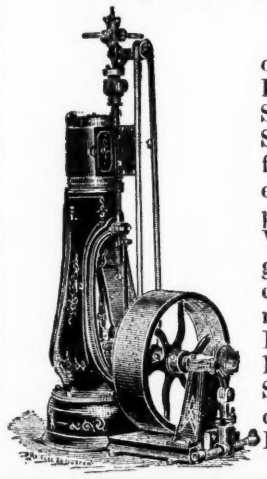

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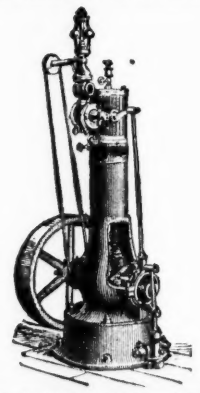

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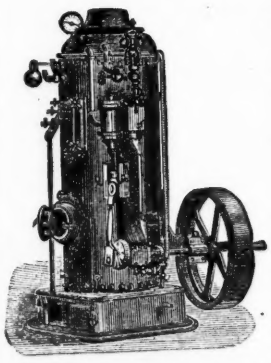

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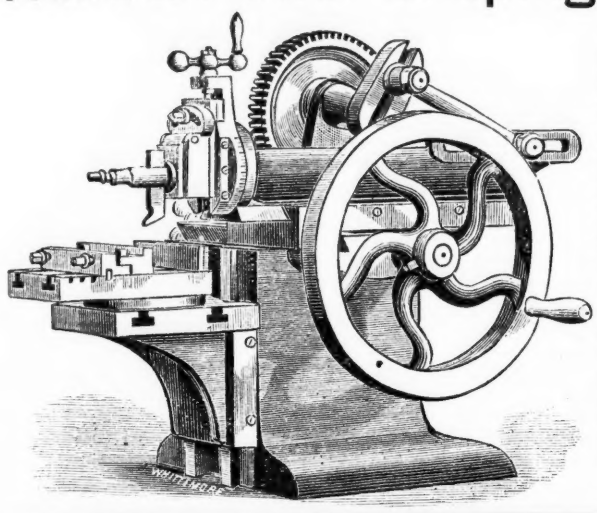

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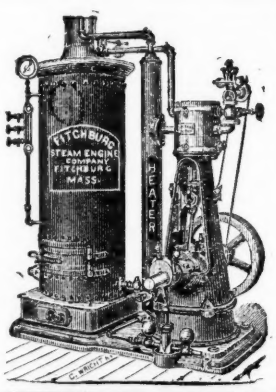

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One Engine Lathe 24 in, swing 12 ft. bed.
One Engine Lathe, 28 in. swing 12 ft. bed,
Two Upright Drills, 27 in. swing, not geared.
One Upright Drill, 22 in. swing, not geared.
One Planer, 24 in. x 24 in. x 4 ft.
Two Planers, 32 in. x 30 in. x 8 ft.
One Planer, 32 in. x 30 in. x 10 ft.
One Planer, 37 in. x 37 in. x 10 ft.
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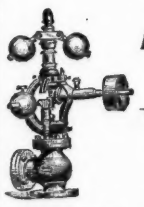

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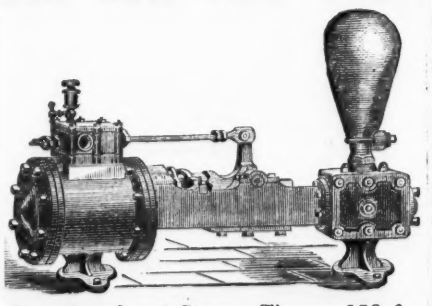

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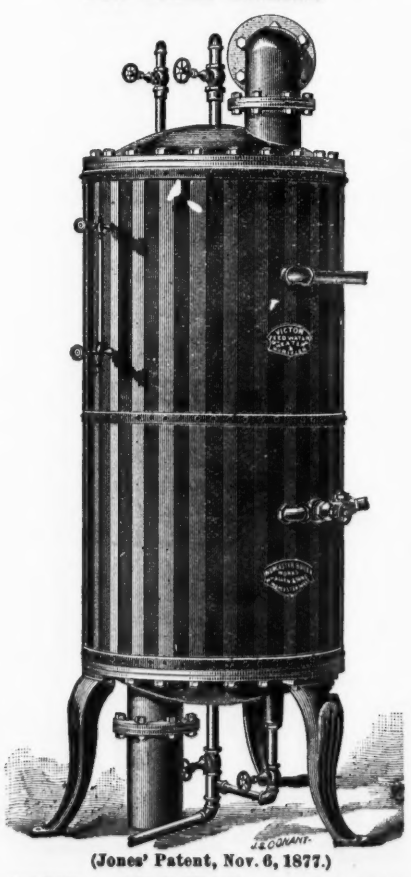

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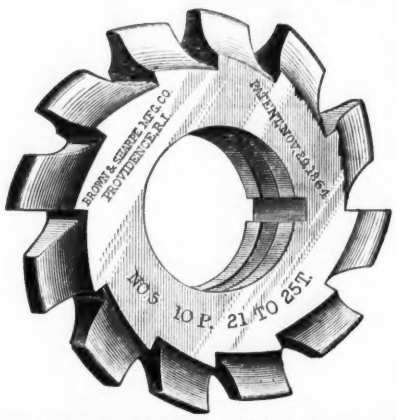

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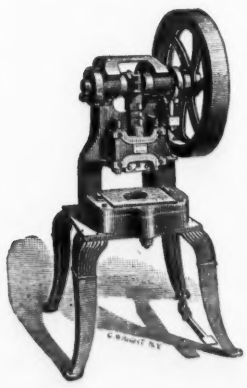

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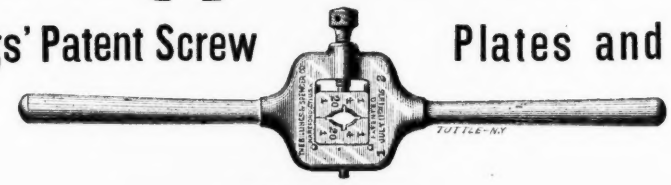
Billings' Patent Screw  **Plates and Dies.**

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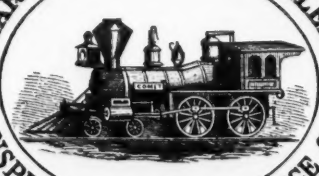

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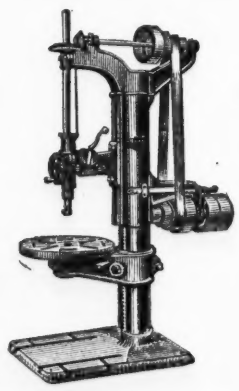

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